SANS DIGITAL

MOBILERAID MR4UT

DETAILED USER'S MANUAL v1.0

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FCC STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

CE Mark

This equipment is in conformity with EM directive.

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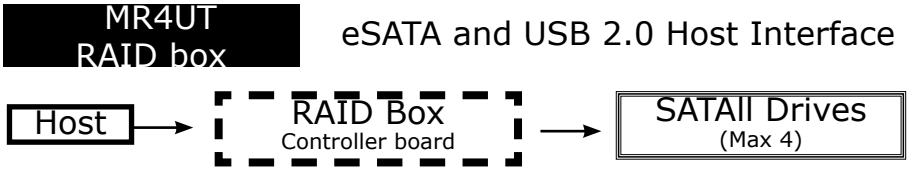
1. Introduction

The MobileRAID MR4UT is a high-performance SATA ll drive bus disk array controller. When properly configured, the RAID box can provide non-stop service with a high degree of fault tolerance through the use of RAID technology and advanced array management features. The RAID box unleashes a truly innovative eSATA (3.0Gbps)/USB2.0 solution for use with your PC and Mac. The HOST interface on the host may be located either on the system board, or on a plug-in host bus adapter (HBA) card. With the host SATA controller supported port multiplier function, both eSATA and USB2.0 host channel can support multiple volumes (up to 4) by Sans Digital's target mode multiplier emulation.

The RAID box allows easy scalability from JBOD to RAID. It can be configured to RAID levels 0, 1, 10, 3, 5, Single Disk or JBOD. The RAID function allows one HDD failure without impact on the existing data and failed drive data can be reconstructed from the remaining data and parity drives. RAID configuration and monitoring can be done through the LCD front control panel, serial port or LAN port. The controller unit is most cost-effective SATA disk drive RAID box with completely integrated high-performance and data-protection capabilities, which meet the performance and features of a midrange storage product at an entry-level price.



1.1 System Architecture

1.1.1 eSATA/USB 2.0 Host Interface

The MobileRAID MR4UT's host interface appears to the host system as a SATA ll or UBS2.0 target device. Your MobileRAID MR4UT uses the latest eSATA technology, allowing interface (or bus) transfer rates of up to 3.0Gbps. The eSATA was developed for the

use of shielded cables outside the PC. The eSATA cable is Fully-shielded cable with separation of the outer shielding (for chassis ground) and signal ground, Hot-plugging supported and Maximum length increased to 2 meters. The USB 2.0 or Hi-Speed USB provides an even greater enhancement in performance—up to 40 times faster than USB 1.1, with a design data rate of 480 Mbps.

1.1.2 SATA ll Drive Interface

The MobileRAID MR4UT communicates directly with the array's 4 SATA ll drives via a built-in SATA interface. When the host is directly controlling the drives, the RAID box controller board translates all communications between the HOST eSATA/USB2.0 and SATA ll devices.

1.2 RAID Box Controller Board

The MobileRAID MR4UT incorporates onboard high performance 400MHz storage processors and on-board DDR2-400 SDRAM memory to deliver true hardware RAID. Designed and leveraged with Sans Digital existing high performance solution, this controller delivers high-capacity performance at the best of cost/performance value. Hardware RAID controllers have their own local RAID processor onboard, plus dedicated onboard cache for full hardware offloading of RAID-processing functions. The ability of hardware RAID controllers to rebuild an array in the event of a drive failure is superior to what software RAID controllers offer.

1.2.1 Unparalleled Performance

MobileRAID MR4UT unleashes the power of 3.0Gbps performance and NCQ support on the eSATA host port. The eSATA port delivers in excess of 210MB/s sustained RAID 5 reads and over 176MB/s RAID 5 sequential writes. The result is superior overall performance compared to other 4 bay eSATA solution. High transfer rates make MobileRAID MR4UT well suited for audio/video application, especially the rapidly growing demand from the Mac Video Editing markets. With the host SATA controller supported port multiplier function, both eSATA and USB2.0 host channel can support multiple volumes (up to 4) by Sans Digital's target mode multiplier emulation.

1.2.2 Unsurpassed Data Availability

The MobileRAID MR4UT provides RAID levels 0, 1, 10, 3, 5, Single Disk or JBOD RAID configurations. Its high data availability and protection derives from the following capabilities: Online RAID Capacity Expansion, Array Roaming, Online RAID Level / Stripe Size Migration, Global Online Spare, Automatic Drive Failure Detection, Automatic Failed Drive Rebuilding, Disk Hot Swap, Online Background Rebuilding, Instant Availability/Background Initialization, Auto Reassign Sector and Redundant Flash Image. Sans Digital greater than two TB support allows for very large volume set application in 64-bit environment such as data-mining and managing large databases.

1.2.3 Easy RAID Management

Manual configuration and monitoring can be done through the LCD Control Panel, RS-232 and LAN port. The LCD Hot-Key supports one-step creation RAID configuration to simplify the firstly setup of MobileRAID MR4UT. It's API library supports customer to write its own monitor utility. The hardware monitor can monitor enclosure voltage, temperature and FAN.

Adapter Architecture

- 400MHz storage I/O processor
- Unleash the power of 3.0Gbps and NCQ on the eSATA host port
- NVRAM for RAID configuration & transaction log
- Write-through or write-back cache support
- Redundant flash image for controller availability
- RAID level 0, 1, 10, 3, 5, Single Disk or JBOD
- Multiple RAID selection
- Up to 4 volumes (Target mode multiplier emulation)
- Online array roaming
- Online RAID level/stripe size migration
- Online capacity expansion and RAID level migration simultaneously
- Online dynamic volume set capacity expansion
- Instant availability and background initialization
- Automatic insertion/removal detection and rebuild
- Greater than two TB per volume set

- Support SMART, NCQ, and OOB staggered spin-up capable drives

Monitors/Notification

- Push Buttons and LCD Display Panel for setup and status
- Environment and drive failure indication through LCD, LED and alarm buzzer
- Keep silent and adequate air flow and cooling by intelligent cooling fan speed controller

RAID Management

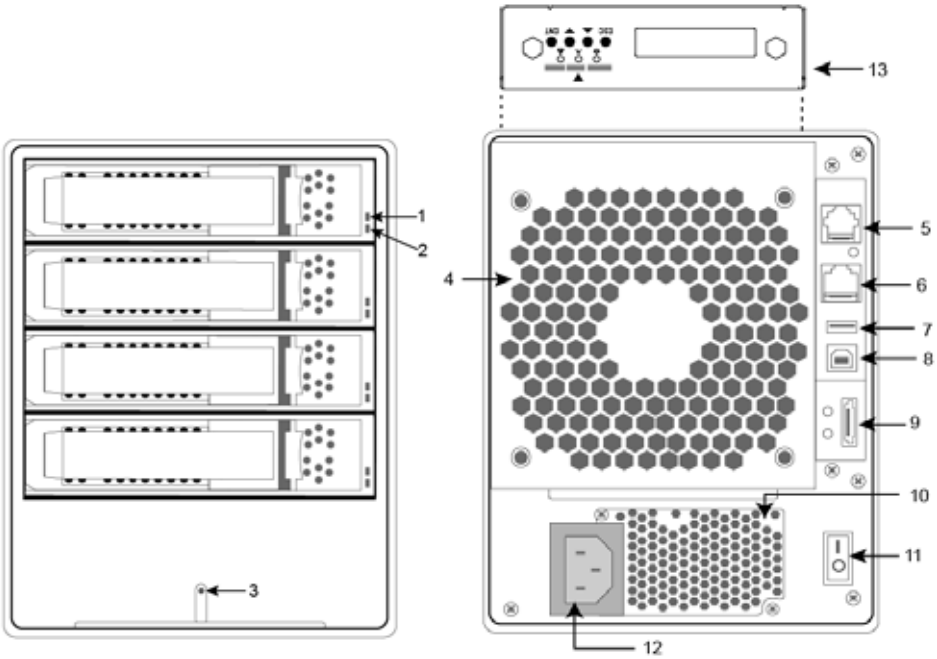
- Field-upgradeable firmware in flash ROM via RS-232 and LAN port
- LCD Hot-Key supports one-step creation RAID configuration
- Firmware-embedded manager via RS-232 port
- Firmware-embedded Browser-based RAID manager, SMTP manager, SNMP agent and Telnet function via LAN port
- Support RAID box's API library for customer to write its own AP

Model Name	MobileRAID MR4UT
Host Interface	eSATA (3.0Gbps) & USB2.0
RAID Support	RAID level 0, 1, 10, 3, 5, Single Disk or JBOD
Disk Interface	4 x SATAII 3Gbps
Enclosure Management	LAN port, RS-232 port and LCD
Cool Fan	3800rpm/0.4A
Form Factor	Compact – 4 Disk Tower
Power Supply/In/out	180W / 90-265V AC / +5V/9A, +12V/9A, +3.3V/4.5A
Dimension	4.84 x 6.51 x 9.11 / 123 x 165.6 x 232 mm
Weight (W/O Drives)	9.0 lbs / 4.1Kg

2. Hardware Installation

2.1 MobileRAID MR4UT

The MobileRAID MR4UT supports four SATA ll channels. For SATA ll drive each channel can run up to 300MB/S.



Front View	Rear View
1. Disk Fault LED 2. Disk Activity LED 3. Power and Global Fault LED	4. System Fan 5. RS232 Port 6. LAN Port 7. USB Port (Drive) 8. USB Port (Host) 9. eSATA port 10. Power Supply Fan 11. On/Off Switch 12. Power Connector 13. LCD Panel with Keypad

2.2 Installation

Step 1. Install the Drives in the MobileRAID MR4UT

1. Gently slide the drive tray out from the MobileRAID MR4UT.
2. Install the drive into the drive tray and secure the drive to the drive tray by four of the mounting screws.

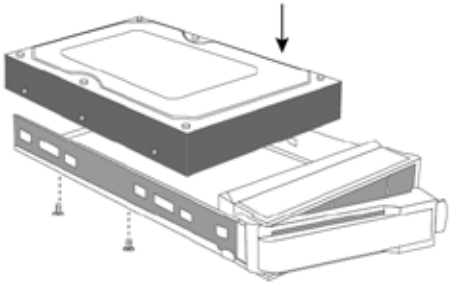


Figure 2-1, Secure the drive to the drive tray

Note:

Please secure four of the mounting screws to the tray, otherwise the MR4UT may produce an annoying BUZZ sound in few environments.

3. After all drives are in the drive tray, slide all of them back into the MobileRAID MR4UT and make sure you latched the drive trays.

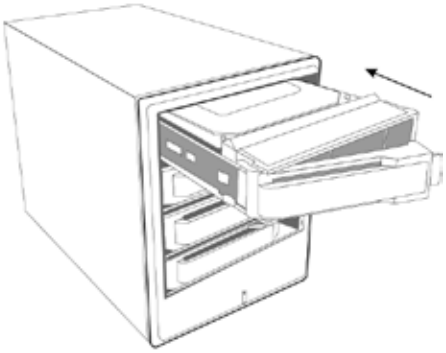


Figure 2-2, Slide drive tray back into the MobileRAID MR4UT

Step 2. Connect the Power

An AC power cord was supplied with your MobileRAID MR4UT. This is the only power cord recommended for use with this product. Connect this power cable to a grounded electrical outlet and to the MobileRAID MR4UT. Turn on the AC power switch from the back of MobileRAID MR4UT.

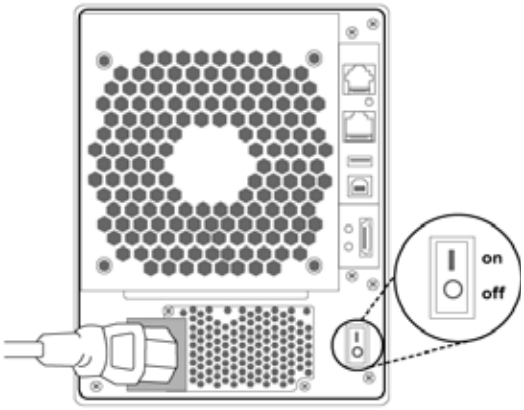


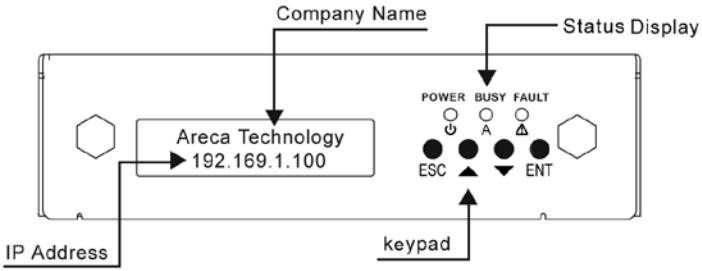
Figure 2-3, Connect the power cable to a grounded electrical outlet and to the MobileRAID MR4UT.

Step 3. Configure RAID Subsystem

The MobileRAID MR4UT is normally delivered with LCD pre-installed. Your MobileRAID MR4UT can be configured by using the LCD with keypad, a serial device (terminal emulation) or LAN port.

- Method 1: LCD Panel with Keypad
  You can use LCD front panel and keypad function to simply create the RAID volume. The LCD status panel also informs you of the disk array's current operating status at a glance. LCD Hot-Key supports one-step creation RAID configuration. For additional information on using the LCD to configure the RAID box see the Chapter 4 of LCD Configuration Menu.

The LCD provides a system of screens with areas for information, status indication, or menus. The LCD screen displays up to two lines at a time of menu items or other information.
The Initial screen is as following:



- Method 2: RS-232 Port Connection
  The MobileRAID MR4UT can be configured via a VT-100 compatible terminal or a PC running a VT-100 terminal emulation program. You can attach a serial (Character-Based) terminal or server com port to the RAID box for access to the text-based setup menu. For additional information on using the RS-232 port to configure the RAID box see the Chapter 5 of VT-100 Utility Configuration.

- Method 3: LAN Port Connection
  The MobileRAID MR4UT has embedded the TCP/IP & Web Browser-based RAID manager in the .firmware. User can remote manage the RAID box without adding any user specific software (platform independent) via standard web browsers directly connected to the 10/100 Ethernet RJ45 LAN port. For additional information on using the LAN port to configure the RAID box see the Chapter 6 of Web Browser-Based Configuration.

Step 4. Connect to Host Computer

Once the MobileRAID MR4UT has finished the initialization of the array, then you can connect it to a host computer. The MobileRAID MR4UT can be connected to a host computer through the Hi-Speed USB 2.0 or eSATA interface. User can use both interfaces connected to the host. When the volume set is ready for system accesses, connect the USB2.0, or/and eSATA cable to the MobileRAID MR4UT and to the appropriate port on host computer.

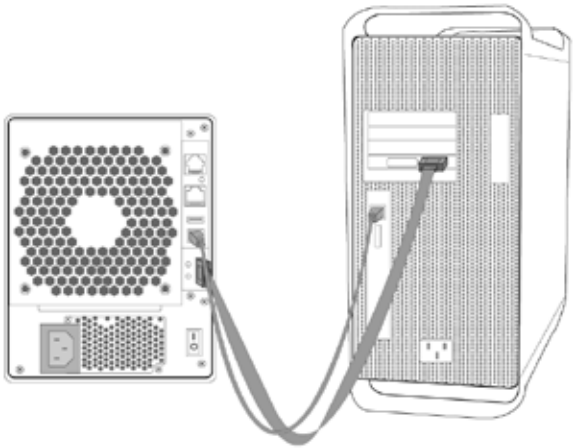


Figure 2-4, Figure 2-3, Connect MobileRAID MR4UT to the host computer.

• eSATA Cables and Connectors

The MobileRAID MR4UT uses the latest in eSATA technology, allowing interface (or bus) transfer rates of up to 3.0Gbps. The eSATA was developed for the use of shielded cables outside the PC. The eSATA cable is fully-shielded cable with separation of the outer shielding (for chassis ground) and signal ground, Hot-plugging supported and maximum length increased to 2 meters. Since the market demand for eSATA external storage is on the rise, a system released almost has added eSATA connectors in the mainboard connector requirements or install a PCI Host controller with external eSATA connection. This provides an easy and reliable way to equip a system with an external SATA connection.

If systems without supporting eSATA connector, you can also use a cable from an internal SATA connector up to a receptacle on a PCI bracket, as shown in Figure 2-5. In this case, it should be noted that the signal from internal controller to the eSATA connector should meet eSATA the electrical compliance requirements outlined. Sans Digital would suggest utilize a PCI or PCIe SATA host controller that supports hot swap, NCQ and SATA PM connections. This can make user to leverage above features supported on the MobileRAID MR4UT.

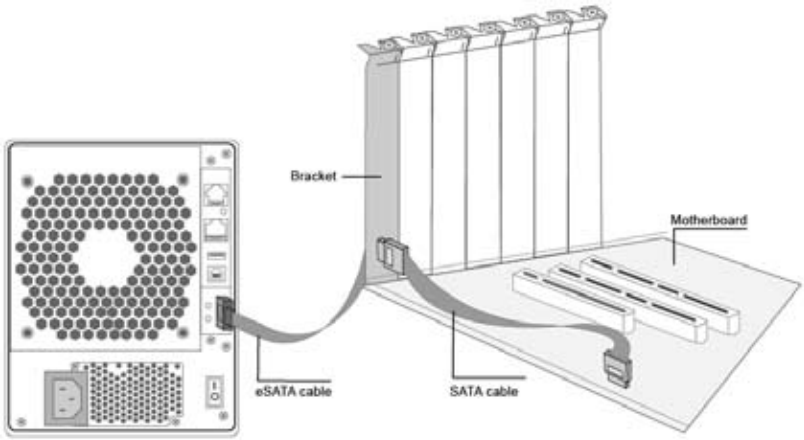
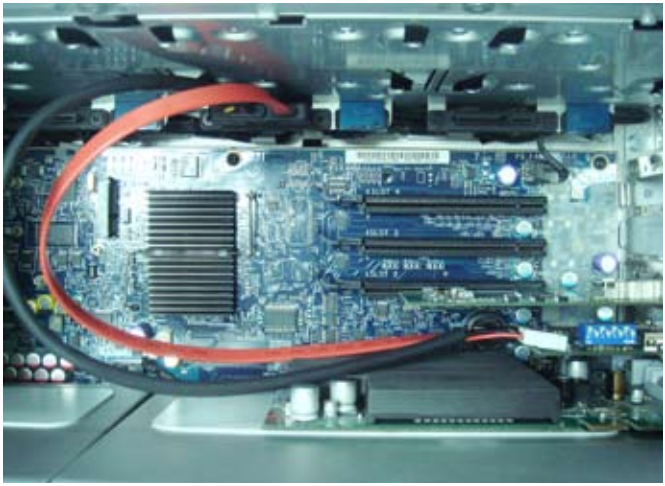


Figure 2-5, An eSATA host connection enabled with a bracket that is cabled to a motherboard SATA connector.

The Mac Pro internal hard drive backplane mounting system is a very nice feature. It comes with four trays and supports up to four internal 3.5" SATA hard drives. Users simply add Sans Digital extension cable from those empty drive backplane to MobileRAID MR4UT re-driver board to have the eSATA connector. Simply screw empty slot bracket to fasten the MR4UT re-driver board. It does not occupy one useable slot. The backplane connector provides power and SATA signal to re-driver board. This can guarantee the signal from Mac pro internal SATA backplane connector to the eSATA connector can meet eSATA the electrical compliance requirements. This low cost solution can boost the performance better than the currently PCIe x1 SATA eSATA host adapter.



In notebook applications, there is an easy way to enable external Serial ATA connectivity through the use of a PCMCIA based controller or a PCIe card. An example of PCIe type of interconnect is shown in Figure 2-6.

Figure 2-6, PCIe adapter card that supports an external SATA interface in a notebook.

Note:

1. MobileRAID MR4UT can support multiple volumes (up to 4) by Sans Digital's target mode multiplier emulation if host controllers support port multiplier function.
2. The eSATA without port multipliers function will be able to recognize one hard drive in the MobileRAID MR4UT.
3. SATA is faster than FireWire 800 and more reliable. Some Mac users have lost data as a result of FireWire firmware changes and that risk continues to exist each time FireWire is altered. That risk does not exist with SATA enclosures as no bridge board is required.

- Hi-Speed USB 2.0 Cables and Connectors
  The MobileRAID MR4UT uses the USB 2.0 or Hi-Speed USB, providing an even greater enhancement in performance—up to 40 times faster than USB 1.1, with a design data rate of 480 Mbps. Your MobileRAID MR4UT is shipped with a Hi-Speed USB 2.0 cable, to ensure maximum data transfer performance when connected to a Hi-Speed USB 2.0 port. This cable can also work when connected to a USB port, but drive performance will be limited to USB 1.1 transfer rates.

Step 5. Turn on Host Computer Power

Safety checks the installation. Connect all power code. Turn on the AC power switch at the rear of host computer then press the power button at the front of the host computer.

Step 6. Format, Partition and Mount the MobileRAID MR4UT Volumes

After you create a unit, it needs to be partitioned, formatted, and mounted by the operating system. There are various steps, that is depend on what operating system you are using (Windows, Linux, FreeBSD or Mac, etc.). Detailed steps for each operating system are provided on their disk utility. After that, the MobileRAID MR4UT can be fully used.

Note:

It is a good idea to turn on your MobileRAID MR4UT before turning on the host computer. This will insure that the host computer recognizes the volumes and drives in the MobileRAID MR4UT. If you turn on the host computer first, be sure of your host controller supporting hot-plug function or rescan command to recognize the MobileRAID MR4UT again.

2.3 Hot-plug Drive Replacement

The MobileRAID MR4UT supports the ability of performing a hot-swap drive replacement without powering down the system. A disk can be disconnected, removed, or replaced with a different disk without taking the system off-line. The MobileRAID MR4UT rebuilding will be processed automatically in the background. When a disk is hot swap, the MobileRAID MR4UT may no longer be fault tolerant. Fault tolerance will be lost until the hot swap drive is subsequently replaced and the rebuild operation is completed.

2.3.1 Recognizing a Drive Failure

A drive failure can be identified in one of the following ways:

1. An error status message lists failed drives.
2. Fault LED illuminates on the front of driver tray if failed drives are inside.

2.3.2 Replacing a Failed Drive

With our MobileRAID MR4UT drive tray, you can replace a defective physical drive while your computer is still operating. When a new drive has been installed, data reconstruction will be automatically started to rebuild the contents of the disk drive. The capacity of the replacement drives must be at least as large as the capacity of the other drives in the RAID set.

3. Configuration Methods

After the hardware installation, the SATA disk drives connected to the RAID box must be configured and the volume set units initialized before they are ready to use. This can be accomplished by one of the following methods:

- Front panel touch-control keypad.
- VT100 terminal connected through the controller's serial port.
- Firmware-embedded & web browser-based RAID manager/SNMP agent/SMTP via the controller's 10/100 LAN port.

Those user interfaces can access the built-in configuration and administration utility that resides in the controller's firmware. They provide complete control and management of the controller and disk arrays, eliminating the need for additional hardware or software.

Note:

The RAID box allows only one method to access menus at a time.

3.1 Using local front panel touch-control keypad

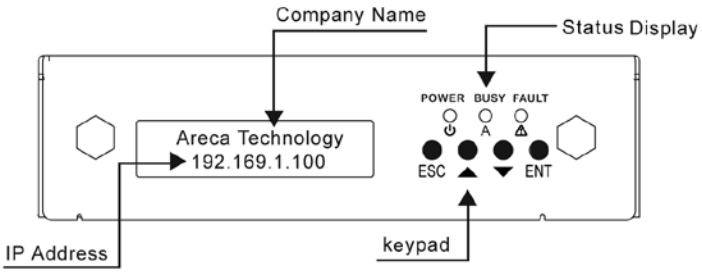
The front panel keypad and liquid crystal display (LCD) is the primary user interface for the RAID box. All configuration and management of the controller and its properly connected disk arrays can be performed from this interface.
The front panel keypad and LCD are connected to the RAID box to access the built-in configuration and administration utility that resides in the controller's firmware. Complete control and management of the array's physical drives and logical units can be performed from the front panel, requiring no additional hardware or software drivers for that purpose.

CONFIGURATION METHOD

A touch-control keypad and a liquid crystal display (LCD) mounted on the back panel of the RAID box is the primary operational interface and monitor display for the disk array controller. This user interface controls all configuration and management functions for the RAID box it is properly connected.

The LCD provides a system of screens with areas for information, status indication, or menus. The LCD screen displays up to two lines at a time of menu items or other information.

The initial screen as the following:



Function Key Definitions:
The four function keys at the button of the front panel perform the following functions:

Key	Function
Up Arrow	Use to scroll the cursor Upward/Rightward
Down Arrow	Use to scroll the cursor Downward/Leftward
ENT Key	Submit Select ion Function (Confirm a selected Item)
ESC Key	Return to Previous Screen (Exit a selection configuration)

There are a variety of failure conditions that cause the RAID box monitoring LED to light. Following table provides a summary of the front panel LED.

Panel LED	Normal Status	Problem Indication
Power LED	Solid green, when power on	Unlit, when power on
Busy LED	Blinking amber during host accesses MR4UT	Unlit or never flicker
Fault LED	Unlit	Solid red

For additional information on using the LCD panel and keypad to configure the RAID controller see "LCD Configuration Menu" on Chapter 4.

3.2 VT100 terminal (Using the controller's serial port)

The serial port on the RAID box's back panel can be used in VT100 mode. The provided interface cable converts the RS232 signal of the 6-pin RJ11 connector on the RAID box into a 9-pin D-Sub female connector. The firmware-based terminal array management interface can access the array through this RS-232 port. You can attach a VT-100 compatible terminal or a PC running a VT-100 terminal emulation program to the serial port for accessing the text-based Setup Menu.

3.2.1 RAID Box RS-232C Port Pin Assignment

To ensure proper communications between the RAID box and the VT-100 Terminal Emulation, Please configure the VT100 terminal emulation settings to the values shown below:

Terminal requirment	
Connection	Null-modem cable
Baud Rate	115,200
Data bits	8
Stop	1
Flow Control	None

The controller RJ11 connector pin assignments are defined as below.

Action			
Pin	Description	Pin	Description
1	RTS	4	GND
2	RXD	5	GND
3	TXD	6	GND

Keyboard Navigation

The following definition is the VT-100 RAID configuration utility keyboard navigation.

Key	Function
Arrow Key	Move cursor
Enter Key	Submit selection function
ESC Key	Return to previous screen
L Key	Line draw
X Key	Redraw

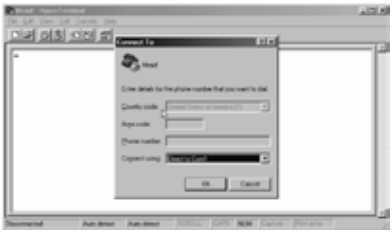
3.2.2 Start-up VT100 Screen

By connecting a VT100 compatible terminal, or a PC operating in an equivalent terminal emulation mode, all RAID box monitoring, configuration and administration functions can be exercised from the VT100 terminal.
There are a wide variety of Terminal Emulation packages, but for the most part they should be very similar. The following setup procedure is an example Setup VT100 Terminal in Windows system using Hyper Terminal use Version 3.0 or higher.

Step 1. From the Desktop open the start menu. Pick Programs, Accessories, Communications and Hyper Terminal. Open Hyper Terminal (requires version 3.0 or higher)

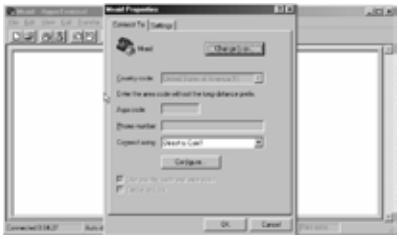
Step 2. Open **HYPERTRM.EXE** and enter a name for your Terminal. Click **OK**.

Step 3. Select an appropriate connecting port in your Terminal. Click OK. Configure the port parameter settings. Bits per second: "**115200**", Data bits: "**8**", Parity: "**None**", Stop bits: "**1**", Flow control:" **None**". Click "**OK"**

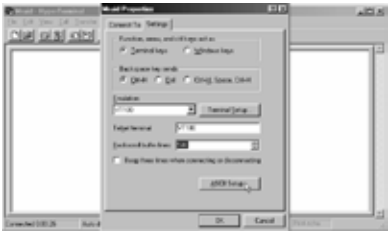


Step 4. Open the File menu, and then open Properties.

Step 5. Open the Settings Tab.



Step 6. Open the Settings Tab. Function, arrow and ctrl keys act as: Terminal Keys, Backspace key sends: "**Crtl+H"**, Emulation: VT100, Telnet terminal: VT100, Back scroll buffer lines: 500. Click **OK**.



Now, the VT100 is ready to use.
After you have finished the VT100 Terminal setup, you may press " **X** " key (in your Terminal) to link the RAID subsystem and Terminal together.
Press" **X** " key to display the disk array Monitor Utility screen on your VT100 Terminal.

3.3 Web browser-based RAID manager

To configure MobileRAID MR4UT on a local or remote machine, you need to know its IP Address. The IP address will default show in the LCD screen or Ethernet Configuration option on the VT100 utility configration. Launch your firmware-embedded TCP/IP & Web Browser-based RAID manager by entering http://[IP Address] in the web browser.

The provided LAN interface cable connects the MobileRAID MR4UT LAN port into a LAN port from your local network. Use only shield cable to avoid radiated emission that may cause interruptions. To ensure proper communications between the RAID subsystem and Web browser-based RAID management, Please connect the RAID box Ethernet LAN port to any LAN switch port.

The MobileRAID MR4UT has embedded the TCP/IP & Web Browser-based RAID manager in the firmware. User can remote manage the RAID box without adding any user specific software (platform independent) via standard web browsers directly connected to the 10/100 Ethernet RJ45 LAN port.

The Storage Console current configuration screen displays the current configuration of your MobileRAID MR4UT. Detail procedures please refer to the Chapter 6 Web Browser-based configuration method.

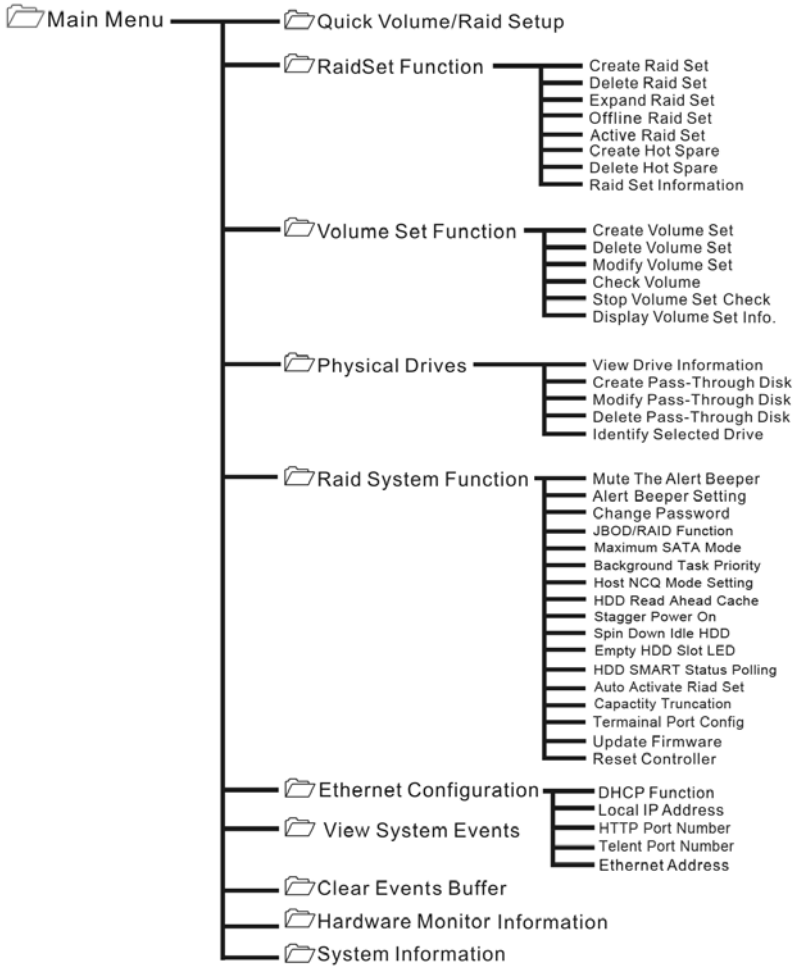
Note:

You must be logged in as administrator with local admin rights on the remote machine to remotely configure it.
The RAID box default user name is "admin" and the password is "0000".

3.4 Configuration Menu Tree

The following is an expansion of the menus in configuration Utility that can be accessed through the LCD panel, RS-232 serial port and LAN port.

CONFIGURATION METHOD



Note:

Ethernet Configuration, Alert By Mail Config, and SNMP Config can only be set in the web-based configuration.

4. LCD Configuration Menu

After the hardware installation, the disk drives connected to the RAID box must be configured and the volume set units initialized before they are ready to use. This can be also accomplished by the Front panel touch-control keypad.

The LCD module on the backside can access the built-in configuration and administration utility that resides in the controller's firmware. To complete control and management of the array's physical drives and logical units can be performed from the front panel, requiring no additional hardware or software drivers for that purpose.

The LCD provides a system of screens with areas for information, status indication, or menus. The LCD screen displays up to two lines at a time of menu items or other information.

The LCD display back panel function keys are the primary user interface for the RAID box. Except for the "Firmware update", all configurations can be performed through this interface.

Function Key Definitions
The four function keys at the back panel of the button perform the following functions:

Key	Function
Up Arrow	Use to scroll the cursor Upward/Rightward
Down Arrow	Use to scroll the cursor Downward/Leftward
ENT Key	Submit Select ion Function (Confirm a selected Item)
ESC Key	Return to Previous Screen (Exit a selection configuration)

4.1 Starting LCD Configuration Utility

After power on the MobileRAID MR4UT, press **ENT** to verify password for entering the main menu from LCD panel. Using the **UP/DOWN** buttons to select the menu item, then press **ENT** to confirm it. Press **ESC** to return to the previous screen.

4.2 LCD Configuration Utility Main Menu Options

Select an option, related information or submenu items to display beneath it. The submenus for each item are explained on the section 4.7.2. The configuration utility main menu options are:

Option	Description
Quick Volume And Raid Set Setup	Create a default configurations which are based on the number of physical disk installed
Raid Set Functions	Create a customized raid set
Volume Set Functions	Create a customized volume set
Physical Drive Functions	View individual disk information
Raid System Functions	Setting the raid system configurations
Ethernet Configuration	Ethernet LAN setting
Show System Events	Record all system events in the buffer
Clear All Event Buffers	Clear all event buffer information
Hardware Monitor Information	Show all system environment status
Show System information	View the controller information

4.3 Configuring Raid Sets and Volume Sets

You can use “Quick Volume And Raid Set Setup" or "Raid Set Functions" and "Volume Set Functions" to configure raid sets and volume sets from LCD panel. Each configuration method requires a different level of user input. The general flow of operations for raid set and volume set configuration is:

Step	Action
1	Designate hot spares/pass-through (optional)
2	Choose a configuration method
3	Create raid set using the available physical drives
4	Define volume set using the space in the raid set
5	Initialize the volume set and use volume set in the host OS

4.4 Designating Drives as Hot Spares

To designate drives as hot spares, press **ENT** to enter the Main menu. Press **UP/DOWN** buttons to select the "Raid Set Functions" option and then press **ENT**. All raid set functions will be displayed. Press up and down arrow to select the "Create Hot Spare Disk" option and then press **ENT**. The first unused physical device connected to the current RAID box appears. Press **UP/DOWN** buttons to scroll the unused physical devices and select the target disk to assign as a Hot Spare and press **ENT** to designate it as a hot spare.

4.5 Using Easy RAID Configuration

In "One-step creation" or "Quick Volume And Raid Setup" configuration, the raid set you create is associated with exactly one volume set, and you can modify the RAID Level, Stripe Size, and Capacity. Designating drives as Hot Spares will also combine with RAID level in this setup.
The volume set default settings will be:
The default setting values can be changed after configuration is completed.

Parameter	Setting
Volume Name	Volume Set#00
Host Channel/ Drive Select	SATA/0
Cache Mode	Write Back
SATA Xfer Mode	SATA300+NCQ

Follow the steps below to create raid set using "One-step creation " "Quick Volume And Raid Setup" configuration:

Step	Action
1	Using "one-step creation" or choose "Quick Volume And Raid Setup" from the main menu. The available RAID levels with hot spare for the current volume set drive are displayed.

2	Recommend use drives have same capacity in a specific array. If you use drives with different capacities in an array, all drives in the raid set will select the lowest capacity of the drive in the raid set. The numbers of physical drives in a specific array determine the RAID levels that can be implemented with the array. RAID 0 requires 1 or more physical drives RAID 1 requires at least 2 physical drives RAID 1+Spare requires at least 3 physical drives RAID 3 requires at least 3 physical drives RAID 5 requires at least 3 physical drives RAID 3 +Spare requires at least 4 physical drives RAID 5 + Spare requires at least 4 physical drives Using **UP/DOWN** buttons to select RAID level for the volume set and press **ENT** to confirm it.
3	Using **UP/DOWN** buttons to create the current volume set capacity size and press **ENT** to confirm it. The available stripe sizes for the current volume set are displayed.
4	Using **UP/DOWN** buttons to select the current volume set stripe size and press **ENT** key to confirm it. This parameter specifies the size of the stripes written to each disk in a RAID 0, 1, 10, or 5 volume set. You can set the stripe size to 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB. A larger stripe size provides better-read performance, especially if your computer does mostly sequential reads. However, if you are sure that your computer does random read requests more often, choose a small stripe size.
5	When you finished defining the volume set, press **ENT** to confirm the "One-Step Creation" or "Quick Volume And Raid Set Setup" function.
6	Press **ENT** to define "FGrnd Init (Foreground initialization)" or press **ESC** to define "BGrnd Init (Background initialization)". When "FGrnd Init", the initialization proceeds must be completed before the volume set ready for system accesses. When "BGrnd Init", the initialization proceeds as a background task, the volume set is fully accessible for system reads and writes. The operating system can instantly access to the newly created arrays without requiring a reboot and waiting the initialization complete.
7	Initialize the volume set you have just configured.
8	If you need to add additional volume set, using main menu "Create Volume Set" functions.

4.6 Using Raid Set and Volume Set Functions

In "Raid Set Function", you can use the create raid set function to generate the new raid set. In "Volume Set Function", you can use the create volume set function to generate its associated volume set and parameters. If the current RAID box has unused physical devices connected, you can choose the "Create Hot Spare" option in the "Raid Set Function" to define a global hot spare.

Select this method to configure new raid sets and volume sets. This configuration option allows you to associate volume set with partial and full raid set.

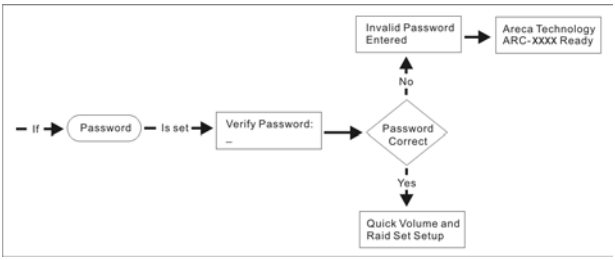
Step	Action
1	To setup the Hot Spare (option), choose "Raid Set Function" from the main menu. Select the "Create Hot Spare" and press **ENT** to set the Hot Spare.
2	Choose "Raid Set Function" from the main menu. Select the "Create Raid Set" and press **ENT**.
3	Select a drive for raid set from the SATA drive connected to the MR4UT
4	Press **UP/DOWN** buttons to select specific physical drives. Press the **ENT** key to associate the selected physical drive with the current raid set. Recommend use drives has same capacity in a specific raid set. If you use drives with different capacities in an array, all drives in the raid set will select the lowest capacity of the drive in the raid set. The numbers of physical drives in a specific raid set determine the RAID levels that can be implemented with the raid set. RAID 0 requires 1 or more physical drives per raid set. RAID 1 requires at least 2 physical drives per raid set. RAID 1 + Spare requires at least 3 physical drives per raid set. RAID 3 requires at least 3 physical drives per raid set. RAID 5 requires at least 3 physical drives per raid set. RAID 3 + Spare requires at least 4 physical drives per raid set. RAID 5 + Spare requires at least 4 physical drives per raid set.
5	After adding physical drives to the current raid set as desired, press **ENT** to confirm the "Create Raid Set" function.
6	An edit the raid set name screen appears. Enter 1 to 15 alphanumeric characters to define a unique identifier for a raid set. The default raid set name will always appear as Raid Set. #. Press **ENT** to finish the name editing.

7	Press **ENT** when you are finished creating the current raid set. To continue defining another raid set, repeat step 3. To begin volume set configuration, go to step 8.
8	Choose "Volume Set Functions" from the Main menu. Select the "Create Volume Set" and press **ENT** .
9	Choose one raid set from the screen. Press **ENT** to confirm it.
10	The volume set attributes screen appears: The volume set attributes screen shows the volume set default configuration value that is currently being configured. The volume set attributes are: Volume Name, Raid Level, Stripe Size, Cache Mode, HOST Channel, Drive Number and SATA Xfer Mode. All value can be changing by the user. Press the **UP/DOWN** buttons to select the attributes. Press the **ENT** to modify each attribute of the default value. Using **UP/DOWN** buttons to select attribute value and press the **ENT** to accept the default value.
11	After user completed modifying the attribute, press **ESC** to enter the select capacity for the volume set. Using the **UP/DOWN** buttons to set the volume set capacity and press **ENT** to confirm it.
12	When you finished defining the volume set, press **ENT** to confirm the Create function.
13	Press **ENT** to define "FGrnd Init (Foreground initialization)" or press **ESC** to define "BGrnd Init (Background initialization)". The controller will begin to initialize the volume set, you have just configured. If space remains in the raid set, the next volume set can be configured. Repeat steps 8 to 13 to configure another volume set.

4.7 Navigation Map of the LCD

The password option allows user to set or clear the raid subsystem's password protection feature. Once the password has been set, the user can only monitor and configure the raid subsystem by providing the correct password. The password is used to protect the MobileRAID MR4UT from unauthorized entry. The RAID box will check the password only when entering the Main menu from the initial screen. The RAID box will automatically go back to the initial screen when it does not receive any command in twenty seconds. The RAID box password is default setting at 0000 by the manufacture.

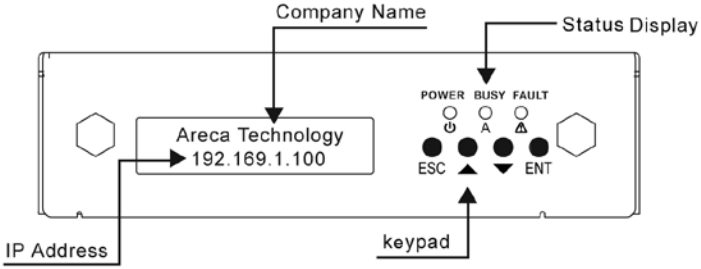
Figure 4.7-1



4.7.1 One-step creation Using LCD Hot Key

This section explains how to use the LCD Hot-Key one-step creation RAID configuration to configure your MobileRAID MR4UT. It is a menu-driven program, residing in the firmware, which allows you to scroll through various menus and submenus and select among the predetermined configuration options. This function provides an easy way to enter the "Quick Volume/Raid Setup" even the member disk of MobileRAID MR4UT having RAID set existed. It only needs a few keystrokes to complete the RAID set and volume set creation.

When starting an MobileRAID MR4UT, it will display the following message on the LCD during the startup:



LCD CONFIGURATION MENU

The LCD configuration manager starts the Hot-Key one-step creation RAID configuration by pressing **DOWN** button three times. If you do not use the one-step creation, press **ENT** to start the main menu of LCD configuration immediately.

The figure 4.7.1-1 is the flow chart of the Hot-Key one-step creation RAID configuration. This option creates a RAID set with the following properties:

1. All of the physical disk drives are contained in a RAID set.
2. The RAID levels associated with hot spare, capacity, and stripe size are selected during the configuration process.
3. A single volume set is created and consumed all or a portion of the disk capacity available in this RAID set.
4. If you need to add additional volume set, using main menu "Volume Set functions". Detailed procedure refer to this chapter section 4.6.

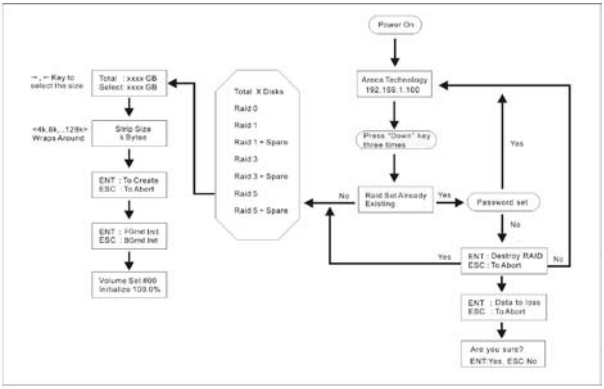
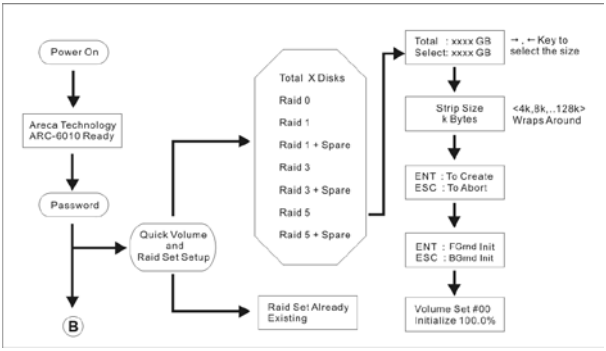


Figure 4.7.1-1

4.7.2 Quick Volume And Raid Setup

"Quick Volume And Raid Setup" is the fastest way to prepare a raid set and volume set. It only needs a few keystrokes to complete it. Although disk drives of different capacity may be used in the raid set, it will use the smallest capacity of the disk drive as the capacity of all disk drives in the raid set. The "Quick Volume And Raid Setup" option creates a raid set with the following properties:

Figure 4.7.2-1

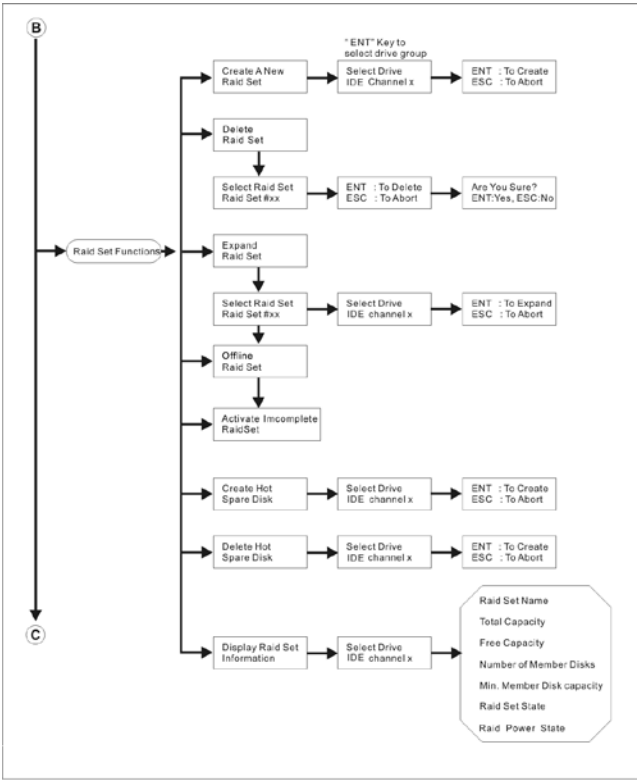


1. All of the physical disk drives are contained in a raid set.
2. The raid levels associated with hot spare, capacity, and stripe size are selected during the configuration process.
3. A single volume set is created and consumed all or a portion of the disk capacity available in this raid set.
4. If you need to add additional volume set, using main menu "Volume Set functions". Detailed procedure refer to this chapter section 4.6.

4.7.3 Raid Set Functions

User manual configuration can complete control of the raid set setting, but it will take longer time to complete than the "Quick Volume And Raid Setup" configuration. Select the "Raid Set Functions" to manually configure the raid set for the first time or deletes existing raid set and reconfigures the raid set.
To enter a "Raid Set Functions", press **ENT** to enter the Main menu. Press **UP/DOWN** buttons to select the "Raid Set Functions" option and then press **ENT** to enter further submenus. All raid set submenus will be displayed.

Figure 4.7.3-1


B
C
Raid Set Functions
Create A New Raid Set
"ENT" Key to select drive group
Select Drive IDE Channel x
ENT : To Create ESC : To Abort
Delete Raid Set
Select Raid Set Raid Set #xx
ENT : To Delete ESC : To Abort
Are You Sure? ENT:Yes, ESC:No
Expand Raid Set
Select Raid Set Raid Set #xx
Select Drive IDE channel x
ENT : To Expand ESC : To Abort
Offline Raid Set
Activate Imcomplete RaidSet
Create Hot Spare Disk
Select Drive IDE channel x
ENT : To Create ESC : To Abort
Delete Hot Spare Disk
Select Drive IDE channel x
ENT : To Create ESC : To Abort
Display Raid Set Information
Select Drive IDE channel x
Raid Set Name
Total Capacity
Free Capacity
Number of Member Disks
Min. Member Disk capacity
Raid Set State
Raid Power State

4.7.3.1 Create A New Raid Set

For detailed procedure please refer to chapter section 4.6.

4.7.3.2 Delete Raid Set

Press **UP/DOWN** buttons to choose the "Delete Raid Set" option. Using **UP/DOWN** buttons to select the raid set number that user want to delete and then press **ENT** to accept the raid set number. The confirmation screen appears, then press **ENT** to accept the delete raid set function. The double confirmation screen appears, then press **ENT** to make sure of the delete existed raid set function

4.7.3.3 Expand Raid Set

Instead of deleting a raid set and recreating it with additional disk drives, the "Expand Existed Raid Set" function allows the user to add disk drives to the raid set that was created.

To expand existed raid set, press **UP/DOWN** buttons to choose the "Expand Raid Set" option. Using **UP/DOWN** buttons to select the raid set number that user want to expand and then press **ENT** to accept the raid set number. If there is an available disk, then the "Select Drive IDE Channel x" appears. Using up and down arrow to select the target disk and then press **ENT** to select it. Press **ENT** to start expanding the existed raid set. The new add capacity will be define one or more volume sets. Follow the instruction presented in the "Volume Set Function" to create the volume sets.

Migrating occurs when a disk is added to a raid set. Migration status is displayed in the raid status area of the "Raid Set information" when a disk is added to a raid set. Migrating status is also displayed in the associated volume status area of the volume set information when a disk is added to a raid set

Note:

1. Once the "Expand Raid Set" process has started, user can not stop it. The process must be completed.
2. If a disk drive fails during raid set expansion and a hot spare is available, an auto rebuild operation will occur after the raid set expansion completes.

4.7.3.4 Offline RAID Set

Press **UP/DOWN** buttons to choose the "Offline RAID Set" option. This function is for coutomer being able to mount and remount a multi-disk volume. All Hdds of the selected Raidset will be put into offline state, spun down and fault LED will be in fast blinking mode.

4.7.3.5 Activate Incomplete RaidSet

When one of the disk drive is removed in power off state, the raid set state will change to Incomplete State. If user wants to continue to work, when the RAID box is power on. User can use the "Activate Incomplete RaidSet" option to active the raid set. After user completed the function, the Raid State will change to Degraded Mode.

4.7.3.6 Create Hot Spare Disk

Please refer to this chapter section 4.4. Designating drives as Hot Spares.

4.7.3.7 Delete Hot Spare Disk

To delete hot spare, press **UP/DOWN** buttons to choose the "Delete Hot Spare Disk" option. Using **UP/DOWN** buttons to select the hot spare number that user want to delete and then press **ENT** to select it. The confirmation screens appear and press **ENT** to delete the hot spare.

4.7.3.8 Display Raid Set Information

Choose the "Display Raid Set Information" option and press **ENT**. Using **UP/DOWN** buttons to select the raid set number. Then the raid set information will be displayed.

Using **UP/DOWN** buttons to see the raid set information, it will show Raid Set Name, Total Capacity, Free Capacity, Number of Member Disks, Min. Member Disk Capacity, Raid Set State and Raid Power Status.

4.7.4 Volume Set Functions

A volume set is seen by the host system as a single logical device. It is organized in a RAID level with one or more physical disks. RAID level refers to the level of data performance and protection of a volume set. A volume set capacity can consume all or a portion of the disk capacity available in a raid set. Multiple volume sets can exist on a group of disks in a raid set. Additional volume sets created in a specified raid set will reside on all the physical disks in the raid set. Thus each volume set on the raid set will have its data spread evenly across all the disks in the raid set.

To enter a "Volume Set Functions", press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the "Volume Set Functions" option and then press **ENT** to enter further submenus. All volume set submenus will be displayed.

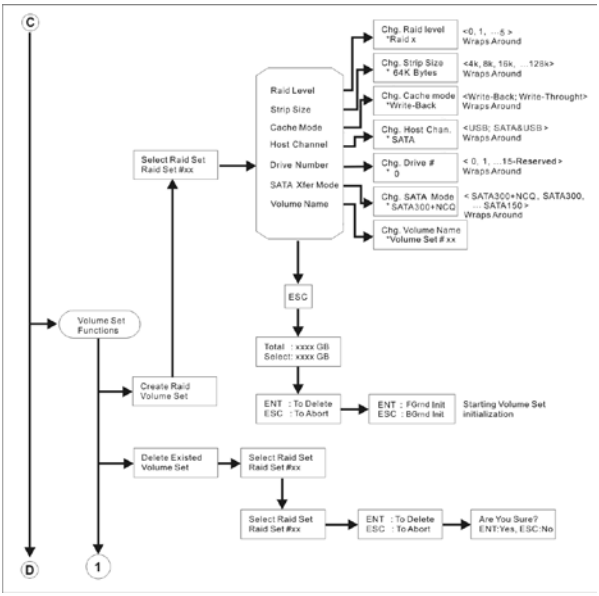
4.7.4.1 Create Raid Volume Set

To create a volume set, Please refer to this chapter section 4.7. Using "Raid Set and Volume Set" Functions. The volume set attributes screen shows the volume set default configuration value that is currently being configured.

The attributes for MR4UT are Raid Level, Stripe Size, Cache Mode, Host Channel, Drive Number, SATA Xfer Mode, and Volume Name (number). See Figure 4.7.4.1-1

All value can be changed by user. Press the **UP/DOWN** buttons to select attribute. Press **ENT** to modify the default value. Using the up and down arrow buttons to select attribute value and press **ENT** to accept the default value. The following is the attributes descriptions. Please refer to this chapter section 4.7 Using Raid Set and Volume Set Functions to complete the create volume set function.

Figure 4.7.4.1-1



4.7.4.1.1 Volume Name

The default volume name will always appear as Volume Set. #. You can rename the volume set name providing it does not exceed the 15 characters limit.

4.7.4.1.2 Raid Level

The RAID box can support raid level 0, 1, 10, 3 and 5.

4.7.4.1.3 Stripe Size

This parameter sets the size of the segment written to each disk in a RAID 0, 1, 10, or 5 logical drive. You can set the stripe size to 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB.

A larger stripe size produces better-read performance, especially if your computer does mostly sequential reads. However, if you are sure that your computer does random reads more often, select a small stripe size.

4.7.4.1.4 Cache Mode

User can set the cache mode as Write-Through Cache or Write-Back Cache.

4.7.4.1.5 Host Channel

There are three kinds of host channel option for each volume to select: SATA, USB, or SATA&USB.

SATA: eSATA host channel can access to the volume set.
USB: USB host channel can access to the volume set.
SATA&USB: Both eSATA and USB host channel can concurrently access the volume set. But user can only write through one channel at the time for data consistency.

4.7.4.1.6 Drive Number

For eSATA host controller with port multiplier function, the eSATA port can support up to 4 volume sets (Drive#: 0~3, 4~15 for Reserved).

For the host controller without port multiplier function, the eSATA port can only support one volume set (Drive#: 0, 1~15 for Reserved).

But the USB port can support up to 4 volume sets (Drive#: 0~3, 4~15 for Reserved).

4.7.4.1.7 SATA Xfer Mode

The MobileRAID MR4UT can support up to SATA ll, which runs up to 300MB/s. NCQ is a command protocol in Serial ATA that can only be implemented on native Serial ATA hard drives. It allows multiple commands to be outstanding within a drive at the same time. Drives that support NCQ have an internal queue where outstanding commands can be dynamically rescheduled or re-ordered, along with the necessary tracking mechanisms for outstanding and completed portions of the workload. The RAID subsystem allows user to choose the SATA Mode (slowest to fastest): SATA150, SATA150+NCQ, SATA300, SATA300+NCQ.

4.7.4.1.8 Capacity

The maximum volume size is default in the first setting. Enter the appropriate volume size to fit your application. The capacity can also increase or decrease by the **UP/DOWN** buttons. Each volume set has a selected capacity which is less than or equal to the total capacity of the raid set on which it resides.

4.7.4.1.9 Initialization Mode

Press **ENT** to define "FGrnd Init (Foreground initialization)" or press **ESC** to define "BGrnd Init (Background initialization)". When "FGrnd Init", the initialization proceeds must be completed before the volume set ready for system accesses. When "BGrnd Init", the initialization proceeds as a background task, the volume set is fully accessible for system reads and writes. The operating system can instantly access to the newly created arrays without requiring a reboot and waiting the initialization complete.

4.7.4.2 Delete Existed Volume Set

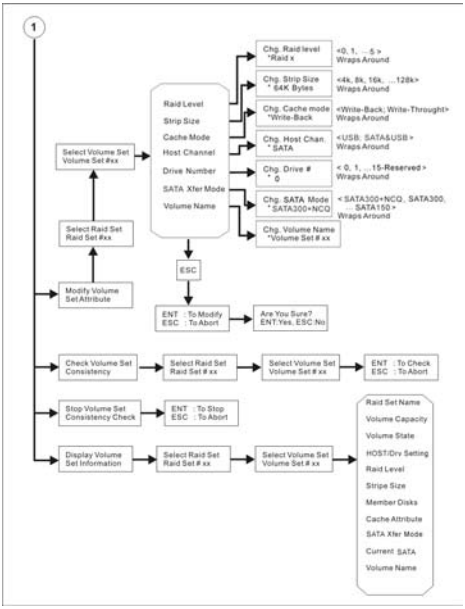
Choose the "Delete Existed Volume Set" option. Using **UP/DOWN** buttons to select the raid set number that user want to delete and press **ENT**. The confirmation screen appears, and then press **ENT** to accept the delete volume set function. The double confirmation screen appears, then press **ENT** to make sure of the delete volume set function.

4.7.4.3 Modify Volume Set Attribute

Use this option to modify volume set configuration. To modify volume set attributes from raid set system function, press up and down arrow to choose the "Modify Volume Set Attribute" option. Using **UP/DOWN** buttons to select the raid set number that user want to modify and press **ENT**.

Press **ENT** to select the existed volume set attribute. The volume set attributes screen shows the volume set setting configuration attributes that was currently being configured. The attributes are Raid Level, Stripe Size, Cache Mode, Host Channel, Drive Number, SATA Xfer Mode and Volume Name (number). All value can be modified by user. Press the **UP/DOWN** buttons to select attribute. Press **ENT** to modify the default value. Using the **UP/DOWN** buttons to select attribute value and press the **ENT** to accept the selection value. Choose this option to display the properties of the selected volume set.

Figure 4.7.4.2-1



4.7.3.3.1 Volume Set Migration

Migrating occurs when a volume set is migrating from one RAID level to another, a volume set strip size changes, or when a disk is added to a raid set. Migration status is displayed in the volume state area of the "Display Volume Set" Information.

4.7.4.4 Check Volume Set Consistency

Use this option to check volume set consistency. To check volume set consistency from volume set system function, press **UP/DOWN** buttons to choose the "Check Volume Set Consistency" option. Using **UP/DOWN** button to select the raid set number that user want to check and press E**NT.** The confirmation screen appears, press **ENT** to start the check volume set consistency.

4.7.4.5 Stop Volume Set Consistency Check

Use this option to stop volume set consistency check. To stop volume set consistency check from volume set system function, press **UP/DOWN** buttons to choose the "Stop Volume Set Consistency Check" option and then press **ENT** to stop the check volume set consistency.

4.7.4.6 Display Volume Set Information

To display volume set information from volume set function, press **UP/DOWN** buttons to choose the "Display Volume Set Information" option. Using **UP/DOWN** buttons to select the raid set number that user wants to show and press **ENT**. The volume set information will show Volume Set Name, Raid Set Name, Volume Capacity, Volume State, HOST/Drv Setting, Raid Level, Stripe Size, Member Disks, Cache Attribute, SATA Xfer Mode and Current SATA. All value cannot be modifying by this option.

4.7.5 Physical Drive Functions

Choose this option from the main menu to select a physical disk and to perform the operations listed below. To enter a physical drive functions, press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the "Physical Drive Functions" option and then press **ENT** to enter further submenus. All physical drive submenus will be displayed.

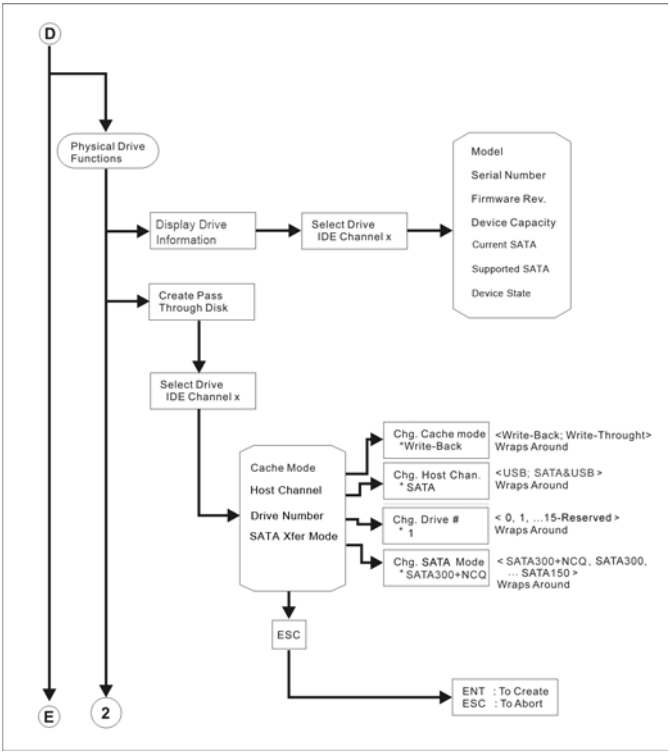


Figure 4.7.5-1

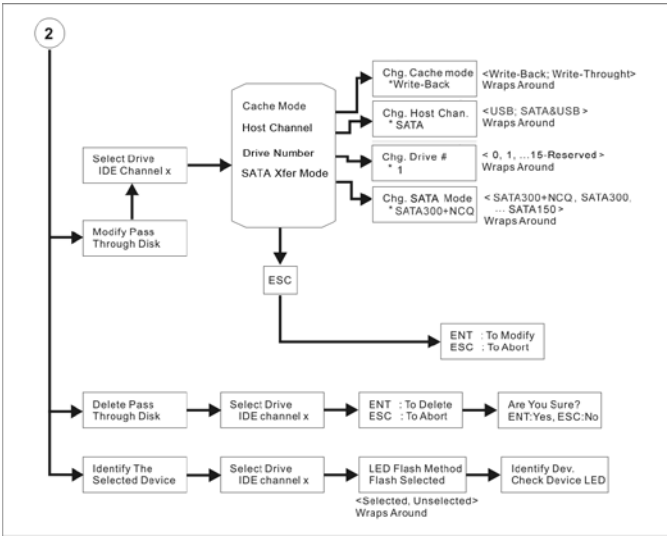


Figure 4.7.5-2

4.7.5.1 Display Drive Information

Using **UP/DOWN** buttons to choose the "Display Drive Information" option and press **ENT**. Using **UP/DOWN** buttons to select the drive IDE number that user want to display. The drive information will be displayed. The drive information screen shows the Model Name, Serial Number, Firmware Rev., Device Capacity, Current SATA, Supported SATA, and Device State.

4.7.5.2 Create Pass Through Disk

Disk is no controlled by the RAID box firmware and thus cannot be a part of a raid set. The disk is available to the operating system as an individual disk. It is typically used on a system where the operating system is on a disk not controlled by the RAID box firmware. Using **UP/DOWN** buttons to choose the "Create Pass-Through Disk" option and press **ENT.** Using **UP/DOWN** buttons to select the drive IDE number that user want to create. The drive attributes will be displayed.

The attributes for Pass-Through disk show the Cache Model, Host Channel, Drive Number, and SATA Xfer Mode.

All values can be changed by user. Press the **UP/DOWN** buttons to attribute and then press **ENT** to modify the default value. Using the up and down arrow buttons to select attribute value and press **ENT** to accept the selection value.

4.7.5.3 Modify Pass Through Disk

To modify Pass Through Disk attributes from Pass Through drive pool, press **UP/DOWN** buttons to choose the "Modify Pass Through Disk" option, and then press **ENT**. The select drive function menu will show all Pass Through disk number items. Using **UP/DOWN** buttons to select the Pass Through Disk that user wants to modify and press **ENT**. The attributes screen shows the Pass Through Disk setting value that was currently being configured.

The attributes for Pass-Through Disk are the Cache Model, Host Channel, Drive Number, and SATA Xfer Mode.

All value can be modified by user. **UP/DOWN** buttons to select attribute. Press **ENT** to modify the default value. Using the up and down arrow buttons to select attribute value and press **ENT** to accept the selection value. After completing the modification, press **ESC** to enter the confirmation screen and then press **ENT** to accept the "Modify Pass Through Disk" function.

4.7.5.4 Delete Pass Through Disk

To delete Pass-Through disk from the pass-through drive pool, press **UP/DOWN** buttons to choose the "Delete Pass Through Disk" option, and then press **ENT**. The Select Drive Function menu will show all Pass Through disk number items. Using **UP/DOWN** buttons to select the Pass Through Disk that user want to delete and press **ENT**. The delete Pass Through confirmation screen will appear, press **ENT** to delete it.

4.7.5.5 Identify The Selected Drive

To prevent removing the wrong drive, the selected disk Fault LED indicator will light for physically locating the selected disk when the "Identify The Selected Drive" function is selected. To identify selected drive from the physical drive pool, press **UP/DOWN** buttons to choose the "Identify The Selected Drive" option, then press **ENT** key. The Select Drive function menu will show all physical drive number items. Using **UP/DOWN** buttons to select the disk that user want to identify and press **ENT**. The selected disk Fault LED indicator will flash.

4.7.6 Raid System Functions

To enter a "Raid System Functions", press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the "Raid System Functions" option and then press **ENT** to enter further submenus. All raid system submenus will be displayed. Using **UP/DOWN** buttons to select the submenus option and then press **ENT** to enter the selection function.

LCD CONFIGURATION MENU

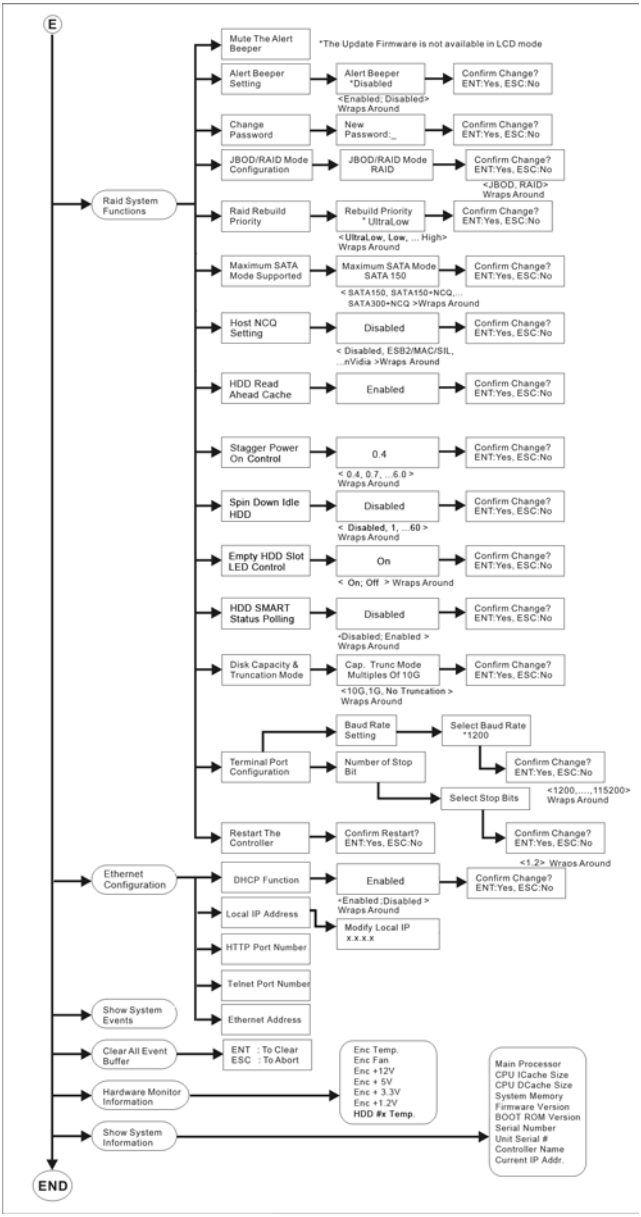


Figure 4.7.6-1

4.7.6.1 Mute The Alert Beeper

The "Mute The Alert Beeper" function item is used to control the RAID box beeper. Select **No** and press **ENT** button to turn the beeper off temporarily. The beeper will still activate on the next event.

4.7.6.2 Alert Beeper Setting

The "Alert Beeper Setting" function item is used to disabled or enabled the RAID box alarm tone generator. Using the **UP/DOWN** buttons to select "Alert beeper Setting" and press **ENT** to accept the selection. After completed the selection, the confirmation screen will be displayed and then press **ENT** to accept the function. Select the "Disabled" and press **ENT** key in the dialog box to turn the beeper off.

4.7.6.3 Change Password

To set or change the RAID box password, press the **UP/DOWN** buttons to select "Change Password" option and then press **ENT** to accept the selection. The New Password: screen appears and enter new password that user want to change. Using **UP/DOWN** buttons to set the password value. After completed the modification, the confirmation screen will be displayed and then press **ENT** to accept the function. Do not use spaces when you enter the password, If spaces are used, it will lock out the user. To disable the password, press **ENT** only in the New Password: column. The existing password will be cleared. No password checking will occur when entering the main menu from the starting screen.

4.7.6.4 JBOD/RAID Mode Configuration

JBOD is an acronym for "Just a Bunch Of Disk". It represents a volume set that is created by the concatenation of partitions on the disks. User needs to delete the RAID set, when you want to

change the option from the RAID to the JBOD function.

4.7.6.5 Raid Rebuild Priority

The "Raid Rebuild Priority" is a relative indication of how much time the controller devotes to a rebuild operation. The RAID box allows user to choose the rebuild priority (UltraLow, Low, ... High) to balance volume set access and rebuild tasks appropriately. To set or change the RAID box's RAID Rebuild Priority, press the **UP/DOWN** buttons to select "RAID Rebuild Priority" and press **ENT** to accept the selection. The rebuild priority selection screen appears and uses the **UP/DOWN** buttons to set the rebuild value. After completing the modification, the confirmation screen will be displayed and then press **ENT** to accept the function.

4.7.6.6 Maximum SATA Mode

Within the subsystem, the eSATA/USB 2.0 acts as a target and 4 SATA ll bus are connected to the drive. The SATA drive channel can support up to SATA ll, which runs up to 300MB/s. NCQ is a command protocol in Serial ATA that can only be implemented on native Serial ATA hard drives. It allows multiple commands to be outstanding within a drive at the same time. Drives that support NCQ have an internal queue where outstanding commands can be dynamically rescheduled or re-ordered, along with the necessary tracking mechanisms for outstanding and completed portions of the workload. The RAID box allows user to choose the SATA Mode: SATA150, SAT150+NCQ, SAT300, SATA300+NCQ.

4.7.6.7 Host NCQ Setting

NCQ is a performance enhancement for SATA II-category disk drives, and works similarly to the way command tag queuing (CTQ) works in SCSI command set-based disk drives. NCQ algorithms allow I/O operations to be performed out of order to optimize and leverage disk read/write head positioning and ultimately overall performance. Since there are some compatible with MR4UT, MR4UT provides the following option to tune the function. The default setting on this option is Disable for bet-

ter compatibility. The MobileRAID MR4UT provides the following host NCQ mode setting.
Disable: No NCQ support
ESB2/MACPro/Siliconlimage: Intel ESB2, MACPro and Siliconimage SATA controller
ICH: Intel ICH series SATA controller
Marvell6145: Marvell 6145 SATA controller
nVidia: Nvida SATA controller

4.7.6.8 HDD Read Ahead Cache

Allow Read Ahead (Default: Enabled)—When Enabled, the drive's read ahead cache algorithm is used, providing maximum performance under most circumstances.

4.7.6.9 Stagger Power On Control

In a PC system with only one or two drives, the power can supply enough power to spin up both drives simultaneously. But in systems with more than two drives, the startup current from spinning up the drives all at once can overload the power supply, causing damage to the power supply, disk drives and other system components. This damage can be avoided by allowing the host to stagger the spin-up of the drives. New SATA drives have support staggered spin-up capabilities to boost reliability. Staggered spin-up is a very useful feature for managing multiple disk drives in a storage subsystem. It gives the host the ability to spin up the disk drives sequentially or in groups, allowing the drives to come ready at the optimum time without straining the system power supply. Staggering drive spin-up in a multiple drive environment also avoids the extra cost of a power supply designed to meet short-term startup power demand as well as steady state conditions.

Sans Digital has supported the fixed value staggered power up function in its previous version firmware. Sans Digital RAID controller has included the option for customer to select the disk drives sequentially stagger power up value. The values can be selected

from 0.4 sec(s) to 6 sec(s) step which powers up one drive.

4.7.6.10 Spin Down Idle HDD

This function can automatically spin down the drive if it hasn't been accessed for a certain amount of time. This value is used by the drive to determine how long to wait (with no disk activity, before turning off the spindle motor to save power.)

4.7.6.11 Empty HDD Slot LED Control

The firmware has added the "Empty HDD Slot LED" option to setup the Fault LED light "ON "or "OFF". When each slot has a power LED for the HDD installed identify, user can set this option to "OFF". Choose option "ON", the MobileRAID MR4UT will light the Fault LED; if no HDD installed.

4.7.6.12 HDD SMART Status Polling

An external RAID enclosure has the hardware monitor in the dedicated backplane that can report HDD temperature status to the controller. However, PCI cards do not use backplanes if the drives are internal to the main server chassis. The type of enclosure cannot report the HDD temperature to the controller. For this reason, HDD SMART Status Polling was added to enable scanning of the HDD temperature function. It is necessary to enable "HDD SMART Status Polling" function before SMART information is accessible. This function is disabled by default.

4.7.6.13 Disk Capacity Truncation Mode

Sans Digital RAID box use drive truncation so that drives from differing vendors are more likely to be able to be used as spares for each other. Drive truncation slightly decreases the usable capacity of a drive that is used in redundant units.
The RAID box provides three truncation modes in the system configuration: Multiples Of 10G, Multiples Of 1G and No Truncation.

Multiples Of 10G: If you have 120 GB drives from different vendors; chances are that the capacity varies slightly. For

example, one drive might be 123.5 GB, and the other 120 GB. "Multiples Of 10G" truncates the number under tens. This makes the same capacity for both of these drives so that one could replace the other.

Multiples Of 1G: If you have 123 GB drives from different vendors; chances are that the capacity varies slightly. For example, one drive might be 123.5 GB, and the other 123.4 GB. "Multiples Of 1G" truncates the fractional part. This makes the same capacity for both of these drives so that one could replace the other.

Disabled: It does not truncate the capacity.

4.7.6.14 Terminal Port Configuration

Parity value is fixed at None.
Handshaking value is fixed at None.
Speed setting values are 1200, 2400, 4800, 9600, 19200,38400, 57600, and 115200.
Stop Bits values are 1 bit and 2 bits.
To set or change the RAID box COMA configuration, press **UP/DOWN** buttons to select "COMA Configuration" and then press **ENT** to accept the selection. The baud rate setting or number of stop bit screen appears and uses **UP/DOWN** buttons to select the setting function. The respect selection screen appears and uses **UP/DOWN** buttons to set the value. After completing the modification, the confirmation screen will be displayed and then press **ENT** to accept the function.

4.7.6.15 Restart Controller

To restart the RAID box, press **UP/DOWN** buttons to select Restart Controller and then press **ENT** to accept the selection. The confirmation screen will be displayed and then press **ENT** to

Note:

It only can work properly at Host and Drive without any activity.

4.7.7 Ethernet Configuration

To configuration Ethernet function, press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the option.

4.7.7.1 DHCP

DHCP (Dynamic Host Configuration Protocol) allows network administrators centrally manage and automate the assignment of IP (Internet Protocol) addresses on a computer network. When using the TCP/IP protocol (Internet protocol), it is necessary for a computer to have a unique IP address in order to communicate to other computer systems. Without DHCP, the IP address must be entered manually at each computer system. DHCP lets a network administrator supervise and distribute IP addresses from a central point. The purpose of DHCP is to provide the automatic (dynamic) allocation of IP client configurations for a specific time period (called a lease period) and to minimize the work necessary to administer a large IP network. To manually configure the IP address of the RAID box, press the **UP/DOWN** buttons to select "Ethernet Configuration" function and press **ENT**. Using **UP/DOWN** buttons to select DHCP, then press **ENT.**

Select the "Disabled" or "Enabled" option to enable or disable the DHCP function. If DHCP is disabled, it will be necessary to manually enter a static IP address that does not conflict with other devices on the network.

4.7.7.2 Local IP Adress

If you intend to set up your client computers manually (no DHCP), make sure that the assigned IP address is in the same range as the default router address and that it is unique to your private network. However, it is highly recommend to use DHCP if that option is available on your network. An IP address allocation scheme will reduce the time it takes to set-up client computers and eliminate the possibilities of administrative errors and duplicate addresses. To manually configure the IP address of the RAID box, press the **UP/DOWN** buttons to select "Ethernet Configuration" function and press **ENT**. Using **UP/DOWN**

buttons to select "Local IP Adress", then press **ENT**. It will show the default address setting in the RAID box You can then reassign the static IP address of the RAID box.

4.7.7.3 HTTP Port Number

To manually configure the HTTP Port Number of the RAID box, press **UP/DOWN** buttons to select “Ethernet Configuration" function and press **ENT**. Using **UP/DOWN** buttons to select "HTTP Port Number", then press **ENT**. It will show the default address setting in the RAID box. Then You can reassign the default HTTP Port Number of the box.

4.7.7.4 Telnet Port Number

To manually configure the Telent Port Number of the RAID box, press the **UP/DOWN** buttons to select “Ethernet Configuration" function and press **ENT**. Using **UP/DOWN** buttons to select "Telent Port Number", then press **ENT**. It will show the default address setting in the RAID box. You can then reassign the default Telent Port Number of RAID box.

4.7.7.5 Ethernet Address

Each Ethernet port has its unique Mac address, which is also factory assigned. Usually, Ethernet Address is used to uniquely identify a port in the Ethernet network.

4.7.8 Show System Events

To view the RAID box events, press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the “Show System Events” option, and then press **ENT**. The system events will be displayed. Press **UP/DOWN** buttons to browse all the system events.

4.7.9 Clear all Event Buffers

Use this feature to clear the entire events buffer information. To clear all event buffers, press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the “Clear all Event Buffers” option, and then press **ENT**. The confirmation message will be

displayed and press **ENT** to clear all event buffers or **ESC** to abort the action.

4.7.10 Hardware Monitor Information

To view the RAID box's hardware monitor information, press **ENT** to enter the main menu. Press **UP/DOWN** buttons to select the "Hardware Information" option, and then press **ENT**. All hardware monitor information will be displayed. Press **UP/DOWN** buttons to browse all the hardware information.
The hardware information provides the temperature, fan speed (chassis fan) and voltage of the RAID box. All items are also unchangeable. The warning messages will indicate through the LCM, LED and alarm buzzer.

4.7.11 System Information

Item	Warning Condition
Enclosure Board Temperature	**> 60°**
Enclosure Fan Speed	**< 1900 RPM**
Enclosure Power Supply +12V	**< 10.5V or > 13.5V**
Enclosure Power Supply +5V	**< 4.7V or > 5.3V**
Enclosure Power Supply +3.3V	**< 3.0V or > 3.6V**
CPU Core Voltage +1.2V	**< 1.08V or > 1.32V**

Choose this option to display Main processor, CPU Instruction cache and data cache size, firmware version, serial number, controller model name, and the cache memory size. To check the system information, press **ENT** to enter the main menu. Press **UP/DOWN** button to select the "Show System Information" option, and then press **ENT**. All major controller system information will be displayed. Press **UP/DOWN** buttons to browse all the system information.

5. VT-100 Utility Configuration

The RAID box configuration utility is firmware-based and uses to configure raid sets and volume sets. Because the utility resides in the RAID controller firmware, its operation is independent of the operating systems on your computer. Use this utility to:

- Create raid set,
- Expand raid set,
- Define volume set,
- Add physical drive,
- Modify volume set,
- Modify RAID level/stripe size,
- Define pass-through disk drives,
- Update firmware,
- Modify system function and,
- Designate drives as hot spares.

Keyboard Navigation

The following definition is the VT-100 RAID configuration utility keyboard navigation.

Key	Function
Arrow Key	Move Cursor
Enter Key	Submit selection function
ESC Key	Return to previous screen
L Key	Line Draw
X Key	Redraw

5.1 Configuring Raid Sets/Volume Sets

You can configure raid sets and volume sets with VT-100 terminal function using "Quick Volume/Raid Setup", or "Raid Set and Volume Set Function" configuration method. Each configuration method requires a different level of user input. The general flow of operations for raid set and volume set configuration is:

Step	Action
1	Designate hot spares/pass-through (optional).
2	Choose a configuration method.
3	Create raid sets using the available physical drives.
4	Define volume sets using the space in the raid set.
5	Initialize the volume sets (logical drives) and use volume sets in the host OS.

5.2 Designating Drives as Hot Spares

All unused disk drive that is not part of a raid set can be created as a Hot Spare. The "Quick Volume/Raid Setup" configuration will automatically add the spare disk drive with the raid level for user to select. For the "Raid Set Function" configuration, user can use the "Create Hot Spare" option to define the hot spare disk drive.
A Hot Spare disk drive can be created when you choose the "Create Hot Spare" option in the "Raid Set Function", all unused physical devices connected to the current controller appear:
Select the target disk by clicking on the appropriate check box.
Press the **Enter** key to select a disk drive, and press **Yes** in the "Create Hot Spare" to designate it as a hot spare.

5.3 Using Quick Volume /Raid Setup Configuration

In "Quick Volume/Raid Setup" configuration, it collects all drives in the tray and include them in a raid set. The raid set you create is associated with exactly one volume set, and you can modify the default RAID level, stripe size, and capacity of the volume set. Designating Drives as Hot Spares will also show in the raid level selection option. The volume set default settings will be:

Parameter	Setting
Volume Name	Volume Set # 00
IDE Host Channel/IDE Drive Select	0/0-Master
Cache Mode	Write Back
Tag Queuing	Yes

VT-100 UTILITY CONFIGURATION

The default setting values can be changed after configuration is complete. Follow the steps below to create arrays using "Quick Volume /Raid Setup" Configuration:

Step	Action
1	Choose "Quick Volume/Raid Setup" from the main menu. The available RAID levels with hot spare for the current volume set drive are displayed.
2	Recommend use drives have same capacity in a specific array. If you use drives with different capacities in an array, all drives in the raid set will select the lowest capacity of the drive in the raid set. The numbers of physical drives in a specific array determine the RAID levels that can be implemented with the array. RAID 0 requires 1 or more physical drives. RAID 1 requires at least 2 physical drives. RAID 1+Spare requires at least 3 physical drives. RAID 3 requires at least 3 physical drives. RAID 5 requires at least 3 physical drives. RAID 3 +Spare requires at least 4 physical drives. RAID 5 + Spare requires at least 4 physical drives. Highlight RAID level for the volume set and press **Enter** to confirm it.
3	Set the capacity size for the current volume set. After Highlight RAID level and press **Enter**. The selected capacity for the current volume set is displayed. Using the up and down arrow key to create the current volume set capacity size and press **Enter** key to confirm it. The available stripe sizes for the current volume set are displayed.
4	Using up and down arrow key to select the current volume set stripe size and press **Enter** key to confirm it. This parameter specifies the size of the stripes written to each disk in a RAID 0, 1, 10 or 5 Volume Set. You can set the stripe size to 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB. A larger stripe size provides better-read performance, especially if your computer does mostly sequential reads. However, if you are sure that your computer does random read requests more often, choose a small stripe size.
5	When you are finished defining the volume set, press **Enter** key to confirm the "Quick Volume And Raid Set Setup" function.
6	Press **Enter** key to define "Foreground Initialization" , "Background Initialization" or "No Init (To Rescue Volume)". When "Foreground Initialization", the initialization proceeds must be completed before the volume set ready for system accesses. When background Initialization, the initialization proceeds as a background task, the volume set is fully accessible for system reads and writes. The operating system can instantly access to the newly created arrays without requiring a reboot and waiting the initialization complete. The "No Init (To Rescue Volume)" option is for customer to rescue volume without losing data in the disk.
7	Initialize the volume set you have just configured.
8	If you need to add additional volume set, using main menu "Create Volume Set" function

5.4 Using Raid Set/Volume Set Function Method

In "Raid Set Function", you can use the "Create Raid Set" function to generate the new raid set. In "Volume Set Function", you can use the "Create Volume Set" function to generate its associated volume set and parameters.
If the current controller has unused physical devices connected, you can choose the "Create Hot Spare" option in the "Raid Set Function" to define a global hot spare. Select this method to configure new raid sets and volume sets. The "Raid Set/Volume Set Function" configuration option allows you to associate volume set with partial and full raid set.

Note:

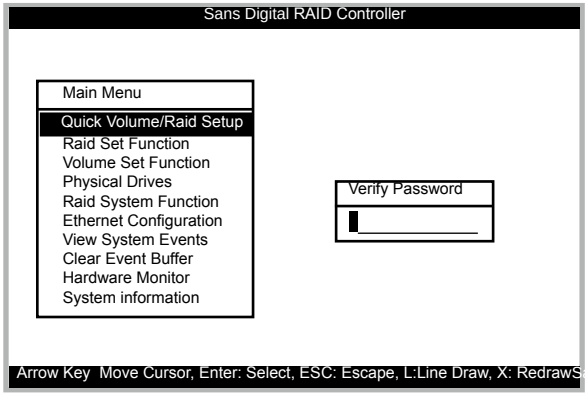
User can use this method to examine the existing configuration. Modify volume set configuration method provides the same functions as create volume set configuration method. In volume set function, you can use the modify volume set function to modify the volume set parameters except the capacity size.

Step	Action
1	To setup the Hot Spare (option), choose "Raid Set Function" from the main menu. Select the "Create Hot Spare" and press **Enter** key to set the Hot Spare.
2	Choose "Raid Set Function" from the main menu. Select the "Create Raid Set" and press **Enter** key.
3	"Select a Drive For Raid Set" screen is displayed showing the IDE drive connected to the current controller.

4	Press **UP/DOWN** buttons to select specific physical drives. Press the **Enter** key to associate the selected physical drive with the current raid set. Recommend use drives has same capacity in a specific raid set. If you use drives with different capacities in an array, all drives in the raid set will select the lowest capacity of the drive in the raid set. The numbers of physical drives in a specific raid set determine the RAID levels that can be implemented with the raid set. RAID 0 requires 1 or more physical drives. RAID 1 requires at least 2 physical drives. RAID 1+Spare requires at least 3 physical drives. RAID 3 requires at least 3 physical drives. RAID 5 requires at least 3 physical drives. RAID 3 +Spare requires at least 4 physical drives. RAID 5 + Spare requires at least 4 physical drives
5	After adding physical drives to the current raid set as desired, press **Yes** to confirm the "Create Raid Set" function.
6	An "Edit The Raid Set Name" dialog box appears. Enter 1 to 15 alphanumeric characters to define a unique identifier for a raid set. The default raid set name will always appear as Raid Set. #. Press **Enter** to finish the name editing.
7	Press **Enter** key when you are finished creating the current raid set. To continue defining another raid set, repeat step 3. To begin volume set configuration, go to step 8.
8	Choose "Volume Set Function" from the main menu. Select the "Create Volume Set" and press **Enter** key.
9	Choose one raid set from the "Create Volume From Raid Set" screen. Press **Enter** key to confirm it.
10	Press **Enter** key to define "Foreground Initialization" , "Background Initialization" or "No Init (To Rescue Volume)". When "Foreground Initialization", the initialization proceeds must be completed before the volume set ready for system accesses. When background Initialization, the initialization proceeds as a background task, the volume set is fully accessible for system reads and writes. The operating system can instantly access to the newly created arrays without requiring a reboot and waiting the initialization complete. The "No Init (To Rescue Volume)" option is for customer to rescue volume without losing data in the disk.
11	If space remains in the raid set, the next volume set can be configured. Repeat steps 8 to 10 to configure another volume set.

5.5 Main Menu

The main menu shows all function that enables the customer to execute actions by clicking on the appropriate link.



Note:

The manufacture default password is set to 0000, this password can be by selected the "Change Password" in the section of "Raid System Function".

Option	Description
Quick Volume/Raid Setup	Create a default configuration which based on numbers of physical disk installed
Raid Set Function	Create a customized raid set
Volume Set Function	Create a customized volume set
Physical Drives	View individual disk information
Raid System Function	Setting the raid system configuration
Ethernet Configuration	Ethernet LAN Setting
View System Events	Record all system events in the buffer
Clear Event Buffer	Clear all event buffer information
Hardware Monitor	Show all system environment status
System Information	View the controller information

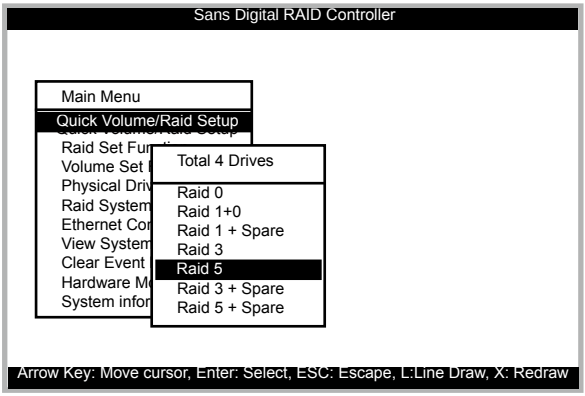
This password option allows user to set or clear the raid box's password protection feature. Once the password has been set, user can only monitor and configure the raid box by providing the correct password. The password is used to protect the MobileRAID MR4UT from unauthorized entry. The MobileRAID MR4UT will check the password only when entering the main menu from the initial screen. The RAID box will automatically go back to the initial screen when it does not receive any command in twenty seconds.

5.5.1 Quick Volume/Raid Setup

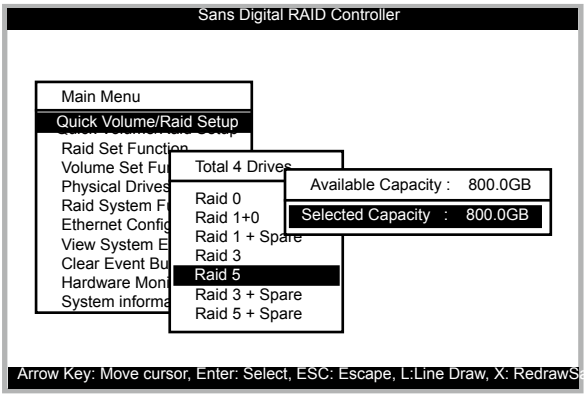
"Quick Volume/Raid Setup" is the fastest way to setup a raid set and volume set. It only needs a few keystrokes to complete it. Although disk drives have different capacity may be used in the raid set, it will use the smallest capacity of disk drive as the capacity of all disk drives in the raid set. The "Quick Volume/Raid Setup" option creates a raid set with the following properties:

1. All of the physical drives are contained in a raid set.
2. The raid levels associated with hot spare, capacity, and stripe size are selected during the configuration process.
3. A single volume set is created and consumed all or a portion of the disk capacity available in this raid set.
4. If you need to add additional volume set, using main menu "Create Volume Set" function.

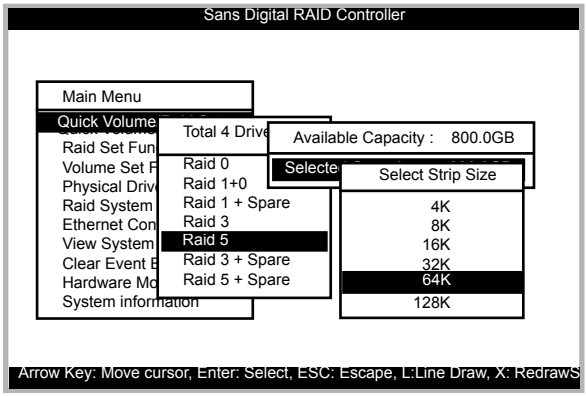
The total physical drives in a specific raid set determine the RAID levels that can be implemented with the raid set. Press the "Quick Volume/RAID Setup" from the main menu; all possible RAID levels screen will be displayed.



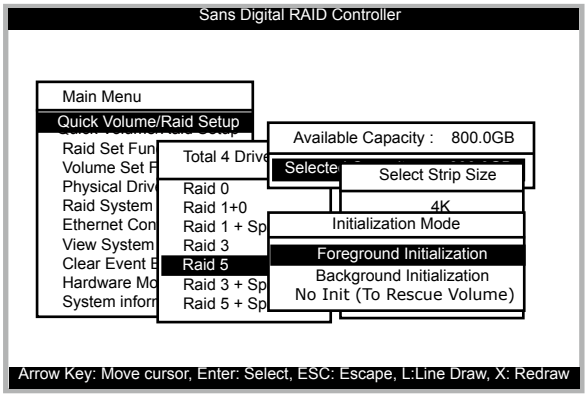
A single volume set is created and consumed all or a portion of the disk capacity available in this raid set. Define the capacity of volume set in the "Available Capacity" popup. The default value for the volume set is displayed in the selected capacity. To enter a value less than the available capacity, type the value and press the **Enter** key to accept this value. If it only use part of the raid set capacity, you can use the "Create Volume Set" option to define another volume sets.



Stripe size This parameter sets the size of the stripe written to each disk in a RAID 0, 1, 10 or 5 logical drive. You can set the stripe size to 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB.
A larger stripe size produces better-read performance, especially if your computer does mostly sequential reads. However, if you are sure that your computer does random reads more often, select a small stripe size.

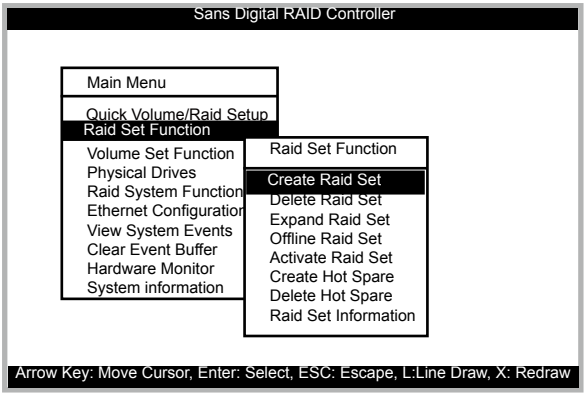


Press the **Yes** key in the "Create Vol/Raid Set" dialog box, the "Initialization Mode" dialog box will appear. Select the mode for initialize, the raid set and volume set will start to initialize it.



5.5.2 Raid Set Function

User manual configuration can complete control of the raid set setting, but it will take longer time to complete than the "Quick Volume/Raid Setup" configuration. Select the "Raid Set Function" to manually configure the raid set for the first time or delete existed raid set and re-configure the raid set.

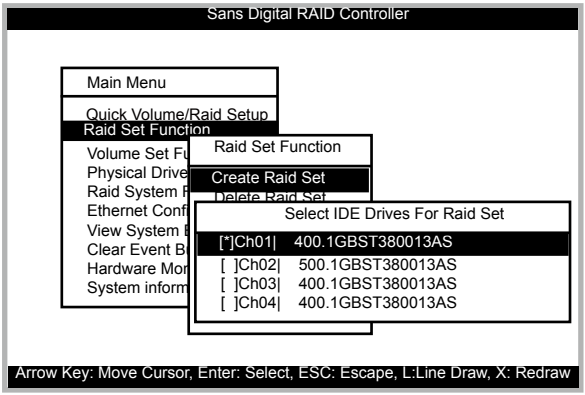


5.5.2.1 Create Raid Set

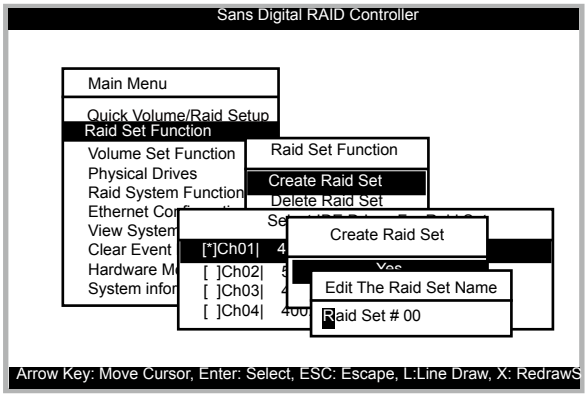
To define raid set, follow the procedure below:

1. Select "Raid Set Function" from the main menu.
2. Select "Create Raid Set" option from the "Raid Set Function" dialog box.
3. A "Select IDE Drives For Raid Set" window is displayed showing the IDE drive connected to the current controller. Press the up and down arrow keys to select specific physical drives. Press the **Enter** key to associate the selected physical drive with the current raid set. Repeat this step, as many disk drives as user want to add in a single raid set.

To finish selecting "IDE drives For Raid Set", press **Esc** key. A create raid set confirmation screen appears, Press **Yes** key to confirm it.

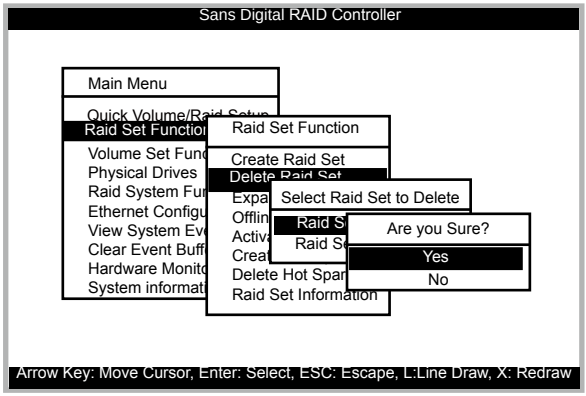


4. An "Edit The Raid Set Name" dialog box appears. Enter 1 to 15 alphanumeric characters to define a unique identifier for a raid set. The default raid set name will always appear as Raid Set. #.



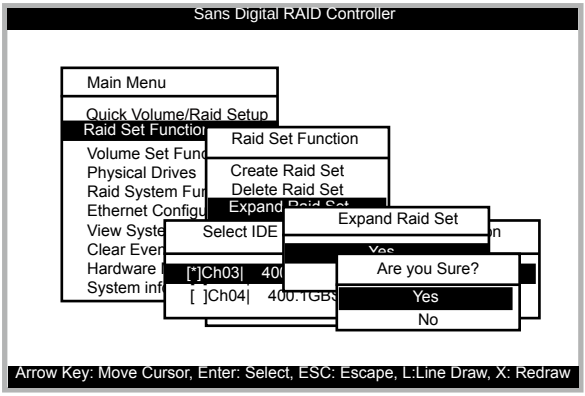
5.5.2.2 Delete Raid Set

To change a raid set, you should first delete it and re-create the raid set. To delete a raid set, select the raid set number that user want to delete in the "Select Raid Set to Delete" screen. The "Delete Raid Set" dialog boappears, then press **Yes** key to delete it.



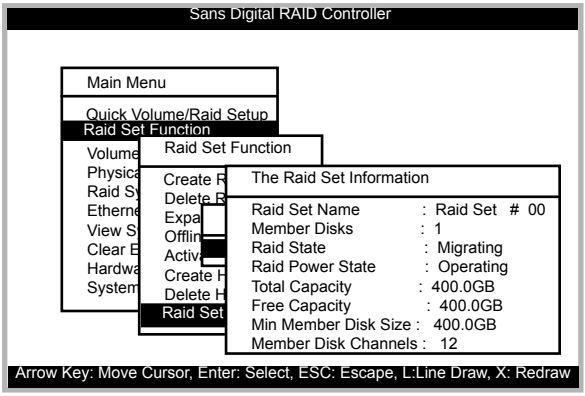
5.5.2.3 Expand Raid Set

Instead of deleting a raid set and recreating it with additional disk drives, the "Expand Raid Set" function allows the users to add disk drive to the raid set that was created.



To expand a raid set:
Click on "Expand Raid Set" option. If there is an available disk, then the "Select IDE Drives For Raid Set Expansion" screen appears. Select the target raid set by clicking on the appropriate radial button. Select the target disk by clicking on the appropriate check box. Press **Yes** to start expand the raid set.
The new add capacity will be define one or more volume sets. Follow the instruction presented in the "Volume Set Function" to create the volume set.

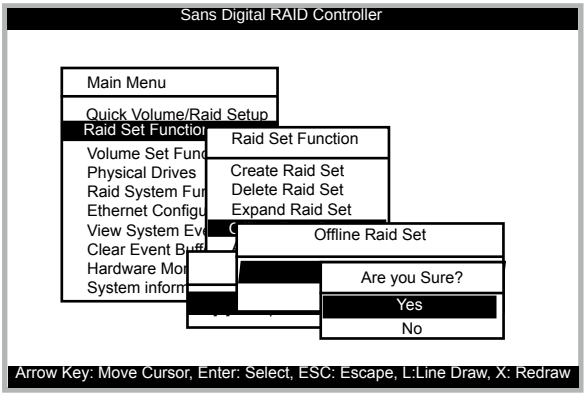
- **Migrating**


Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Raid Set Function
Raid Set Function
The Raid Set Information
Raid Set Name : Raid Set # 00
Member Disks : 1
Raid State : Migrating
Raid Power State : Operating
Total Capacity : 400.0GB
Free Capacity : 400.0GB
Min Member Disk Size : 400.0GB
Member Disk Channels : 12
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

Migrating occurs when a disk is added to a raid Set. Migration status is displayed in the raid status area of the "Raid Set information" when a disk is added to a raid set. Migrating status is also displayed in the associated volume status area of the "Volume Set Information" when a disk is added to a raid set.

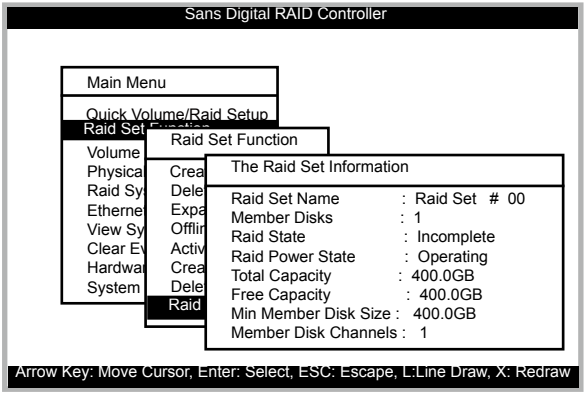
5.5.2.4 Offline Raid Set

This function is for customer being able to unmount and remount a multi-disk volume. All Hdds of the selected raid set will be put into offline state and spun down and fault LED will be in fast blinking mode.



5.5.2.5 Activate Raid Set

The following screen is the "Raid Set Information" after one of its disk drive has removed in the power off state.

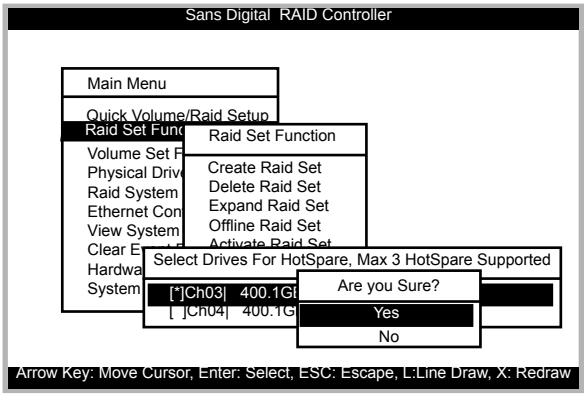

Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Raid Set Function
The Raid Set Information
Raid Set Name : Raid Set # 00
Member Disks : 1
Raid State : Incomplete
Raid Power State : Operating
Total Capacity : 400.0GB
Free Capacity : 400.0GB
Min Member Disk Size : 400.0GB
Member Disk Channels : 1
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

When one of the disk drive is removed in power off state, the raid set state will change to "Incomplete State". If user wants to continue to work, when the RAID box is power on. User can use the "Activate Raid Set" option to active the raid set. After user complete the function, the Raid State will change to Degraded Mode.

5.5.2.6 Create Hot Spare

When you choose the "Create Hot Spare" option in the "Raid Set Function", all unused physical devices connected to the current controller appear.

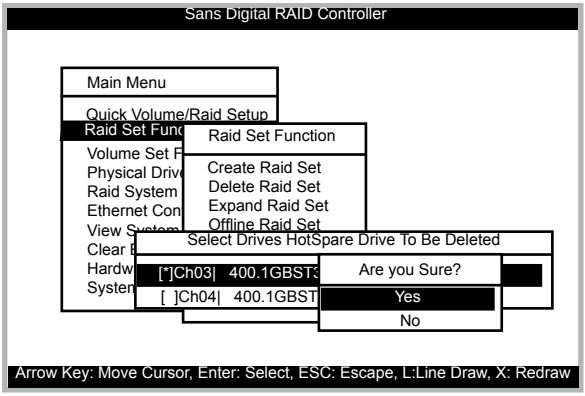
Select the target disk by clicking on the appropriate check box. Press the **Enter** key to select a disk drive and press **Yes** in the "Create Hot Spare" to designate it as a hot spare. The "Create Hot Spare" option gives you the ability to define a global hot spare.



5.5.2.7 Delete Hot Spare

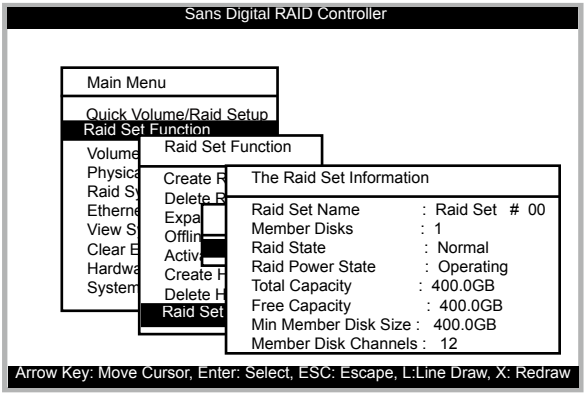
Select the target Hot Spare disk to delete by clicking on the appropriate check box.

Press the **Enter** keys to select a disk drive, and press **Yes** in the "Delete Hot Spare" to delete the hot spare.

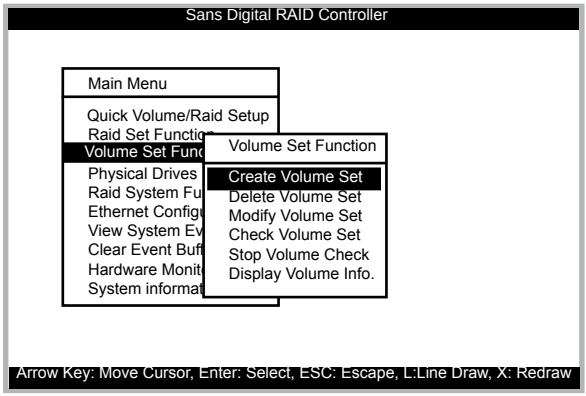


5.5.2.8 Raid Set Information

To display "Raid Set Information", move the cursor bar to the desired raid set number, then press **Enter** key. "The Raid Set Information" will show as above.
You can only view the information of this raid set.


Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Raid Set Function
Raid Set Function
The Raid Set Information
Raid Set Name : Raid Set # 00
Member Disks : 1
Raid State : Normal
Raid Power State : Operating
Total Capacity : 400.0GB
Free Capacity : 400.0GB
Min Member Disk Size : 400.0GB
Member Disk Channels : 12
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

5.5.3 Volume Set Function



A volume vet is seen by the host system as a single logical device. It is organized in a RAID level with one or more physical disks. RAID level refers to the level of data performance and protection of a volume set. A volume set capacity can consume all or a portion of the disk capacity available in a raid set. Multiple volume sets can exist on a group of disks in a raid set. Additional volume sets created in a specified Raid Set will reside on all the physical disks in the raid set. Thus each volume set on the raid set will have its data spread evenly across all the disks in the raid set.

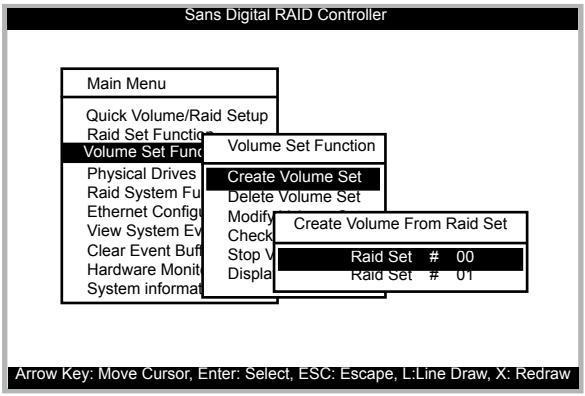
The following steps is the volume set features:

1. Volume sets of different RAID levels may coexist on the same raid set.
2. Up to 4 volume sets in a raid set can be created by the RAID box. (With Host controller supported port multiplier function)
3. The maximum addressable size of a single volume set is not limited to two TB, because the controller is capable of 64-bit LBA mode. However the operating system itself may not be capable of addressing more than two TB.

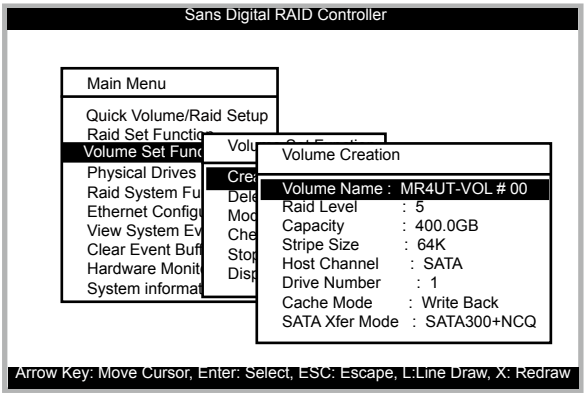
5.5.3.1 Create Volume Set

To create a volume set, following the below steps:

1. Select the "Volume Set Function" from the Main menu.
2. Choose the "Create Volume Set" from "Volume Set Function" dialog box screen.
3. The "Create Volume From Raid Set" dialog box appears. This screen displays the existing arranged raid sets. Select the raid set number and press **Enter** key. The volume creation is displayed in the screen.


Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Volume Set Function
Create Volume Set
Delete Volume Set
Create Volume From Raid Set
Raid Set # 00
Physical Drives
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

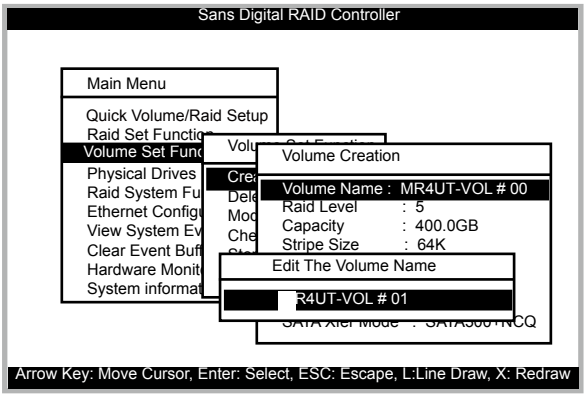
4. A window with a summary of the current volume set's settings. The "Volume Creation" option allows user to select the Volume Name, RAID level, Capacity, Strip Size, Host Channel, Drive Number, Cache Mode and SATA Xfer Mode. User can modify the default values in this screen; the modification procedures are at 5.5.3.1.1 to 5.5.3.1.8 section.


Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Volume Creation
Volume Name : MR4UT-VOL # 00
Raid Level : 5
Capacity : 400.0GB
Stripe Size : 64K
Host Channel : SATA
Drive Number : 1
Cache Mode : Write Back
SATA Xfer Mode : SATA300+NCQ
Physical Drives
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

5. After completing the modification of the volume set, press **Esc** key to confirm it. A "Initialization Mode" screen is presented (only Raid Level 3 and 5).
6. Repeat steps 3 to 5 to create additional volume sets.
7. The initialization percentage of volume set will be displayed at the button line.

5.5.3.1.1 Volume Name

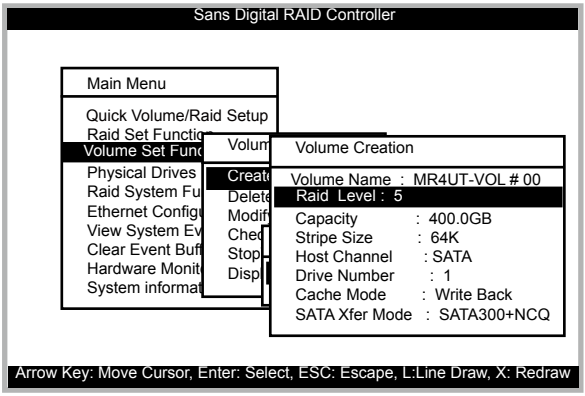
The default volume name will always appear as Volume Set # 00. You can rename the volume set name. It does not exceed the 15 characters limite.



5.5.3.1.2 Raid Level

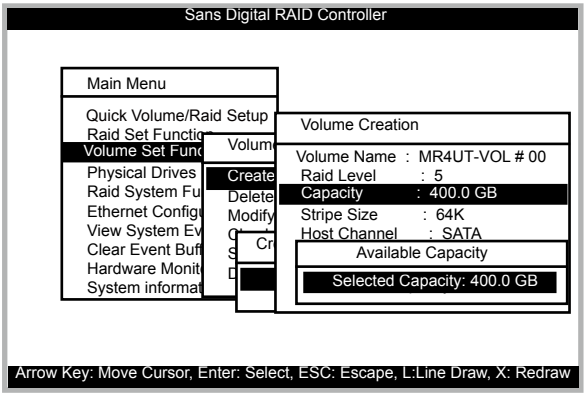
Set the RAID level for the Volume Set. Highlight Raid Level and press **Enter**.

The available RAID levels for the current Volume Set are displayed. Select a RAID level and press **Enter** key to confirm it .



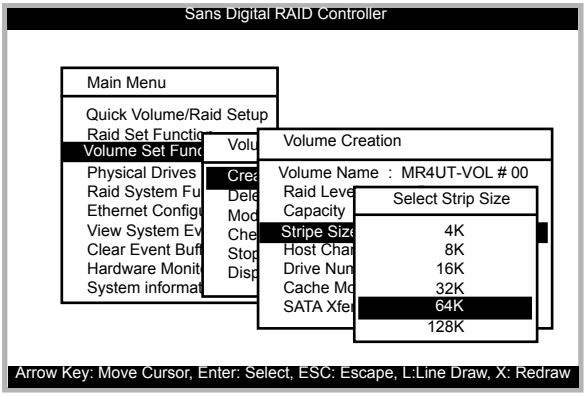
5.5.3.1.3 Capacity

The maximum volume size is default in the first setting. Enter the appropriate volume size to fit your application. The capacity can also increase or decrease by the **UP/DOWN** key. Each volume set has a selected capacity which is less than or equal to the total capacity of the raid set on which it resides.



5.5.3.1.4 Strip Size

This parameter sets the size of the stripe written to each disk in a RAID 0, 1, 10 or 5 logical drive. You can set the stripe size to 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB.

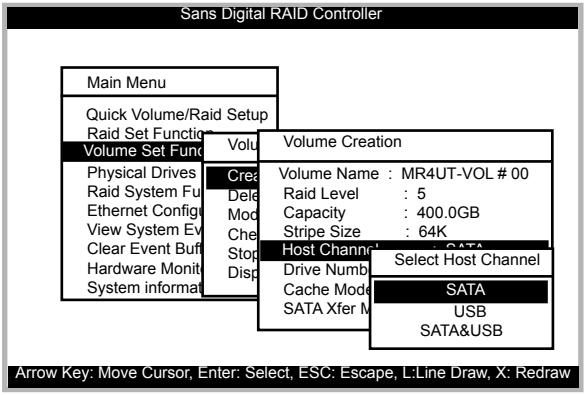


A larger stripe size produces better-read performance, especially if your computer does mostly sequential reads. However, if you are sure that your computer does random reads more often, select a small stripe size.

5.5.3.1.5 Host Channel

There are three kinds of host channel option for each volume to select: SATA, USB, or SATA&USB.

SATA: eSATA host channel can access to the volume set.
USB: USB host channel can access to the volume set.
SATA&USB: Both eSATA and USB host channel can concurrently access the volume set. But user can only write through one channel at the time for data consistency.

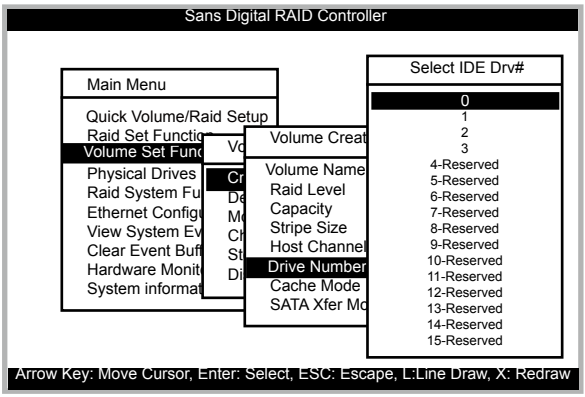


5.5.3.1.6 Drive Number

For eSATA host controller with port multiplier function, the eSATA port can support up to 4 volume sets (Drive#: 0~3, 4~15 for Reserved).

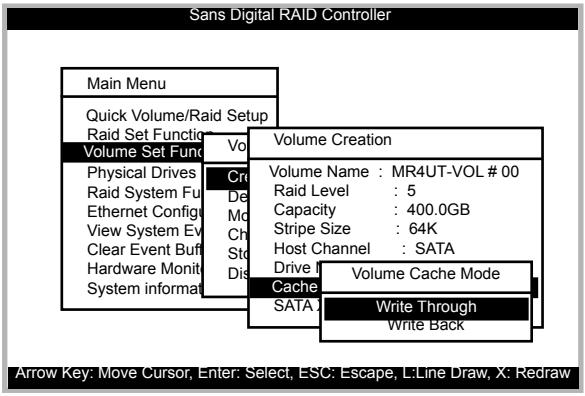
For the host controller without port multiplier function, the eSATA port can only support one volume set (Drive#: 0, 1~15 for Reserved).

But the USB port can support up to 4 volume sets (Drive#: 0~3, 4~15 for Reserved).



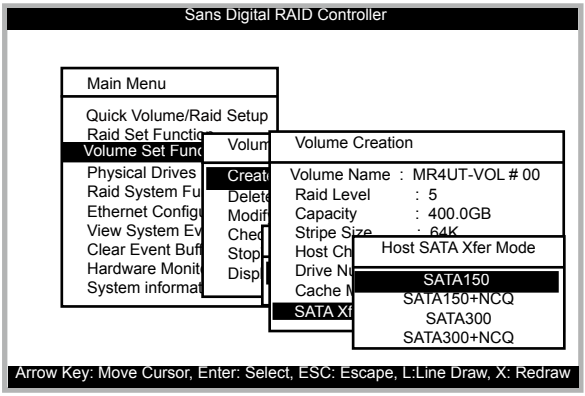
5.5.3.1.7 Cache Mode

User can set the cache mode to: Write-Through Cache or Write-Back Cache.



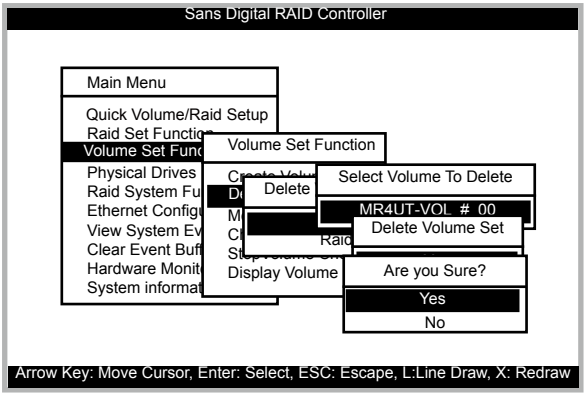
5.5.3.1.8 SATA Xfer Mode

The MobileRAID MR4UT can support up to SATA ll, which runs up to 300MB/s. NCQ is a command protocol in Serial ATA that can only be implemented on native Serial ATA hard drives. It allows multiple commands to be outstanding within a drive at the same time. Drives that support NCQ have an internal queue where outstanding commands can be dynamically rescheduled or re-ordered, along with the necessary tracking mechanisms for outstanding and completed portions of the workload. The RAID subsystem allows user to choose the SATA Mode (slowest to fastest): SATA150, SATA150+NCQ, SATA300, SATA300+NCQ.

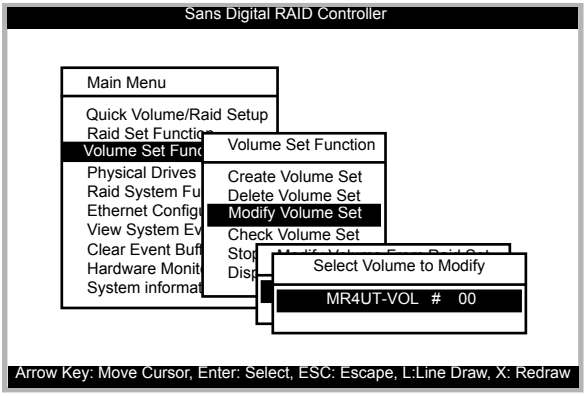


5.5.3.2 Delete Volume Set

To delete volume set from raid set system function, move the cursor bar to the "Volume Set Function" menu and select the "Delete Volume Set" item, then press **Enter** key. The "Volume Set Functions" menu will show all Raid Set # item. Move the cursor bar to an RAID set number, then press **Enter** key to show all volume set # in the raid set. Move cursor to the deleted volume set number, press **Enter** key to delete it.



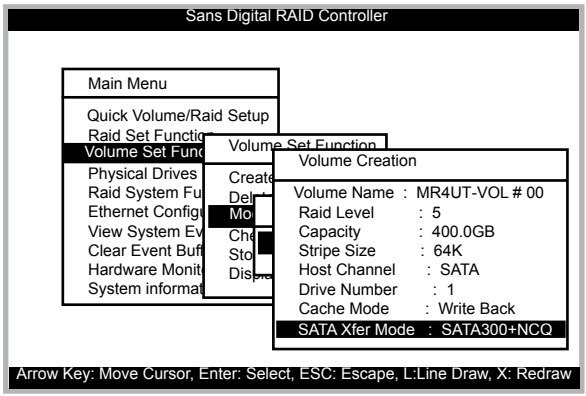
5.5.3.3 Modify Volume Set



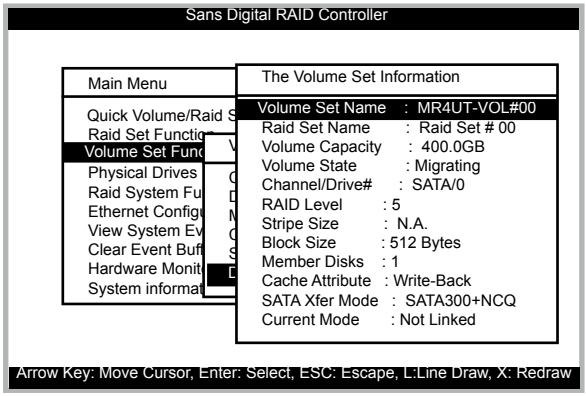
Use this option to modify volume set configuration. To modify volume set values from "Volume Set Function", move the cursor bar to the "Volume Set Functions" menu and select the "Modify Volume Set" item, then press **Enter** key. The "Volume Set Functions" menu will show all Raid set number items. Move the cursor bar to an raid set number item, then press **Enter** key to show all volume set item. Select the volume set from the list you which to change, press **Enter** key to modify it.

5.5.3.3.1 Volume Expansion

Use the raid set expands to expand a raid set, when a disk is added to your system. The expand capacity can use to enlarge the volume set size or create another volume set. The "Modify Volume Set" function can support the volume set expansion function. To expand volume set capacity value from raid set system function, move the cursor bar to the volume set Volume capacity item and entry the capacity size. After you confirm it., the volume set start to expand.
As shown in the above can be modified at this screen. Choose this option to display the properties of the selected Volume set.

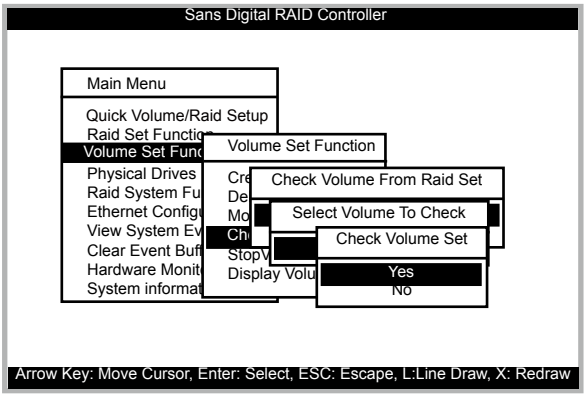

Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Volume Set Function
Volume Creation
Volume Name : MR4UT-VOL # 00
Raid Level : 5
Capacity : 400.0GB
Stripe Size : 64K
Host Channel : SATA
Drive Number : 1
Cache Mode : Write Back
SATA Xfer Mode : SATA300+NCQ
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

5.5.3.3.2 Volume Set Migration


Sans Digital RAID Controller
Main Menu
The Volume Set Information
Volume Set Name : MR4UT-VOL#00
Raid Set Name : Raid Set # 00
Volume Capacity : 400.0GB
Volume State : Migrating
Channel/Drive# : SATA/0
RAID Level : 5
Stripe Size : N.A.
Block Size : 512 Bytes
Member Disks : 1
Cache Attribute : Write-Back
SATA Xfer Mode : SATA300+NCQ
Current Mode : Not Linked
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

Migrating occurs when a volume set is migrating from one RAID level to another, a volume set strip size changes, or when a disk is added to a raid set. Migration status is displayed in the volume status area of the "Volume Set Information".

5.5.3.4 Check Volume Set



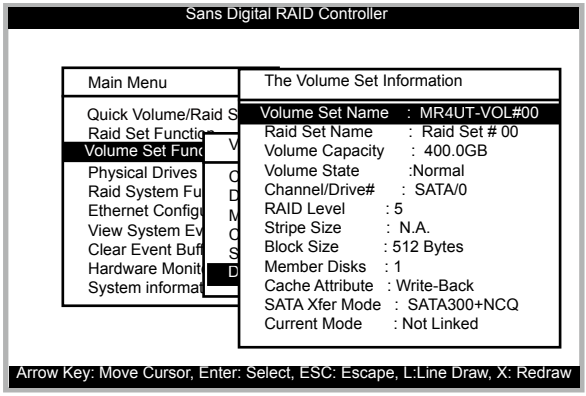
Use this option to verify the correctness of the redundant data in a volume set. For example, in a system with dedicated parity, volume set check means computing the parity of the data disk drives and comparing the results to the contents of the dedicated parity disk drive. To check volume set from raid set system function, move the cursor bar to the "Volume Set Functions" menu and select the "Check Volume Set" item, then press **Enter** key. The "Volume Set Function" menu will show all raid set number items. Move the cursor bar to an raid set number item, then press **Enter** key to show all volume set item. Select the volume set from the list you which to check, press **Enter** key to select it. After completing the selection, the confirmation screen appears, presses **Yes** to start check.

5.5.3.5 Stop Volume Set Check

Use this option to stop all the "Check Volume Set" function.

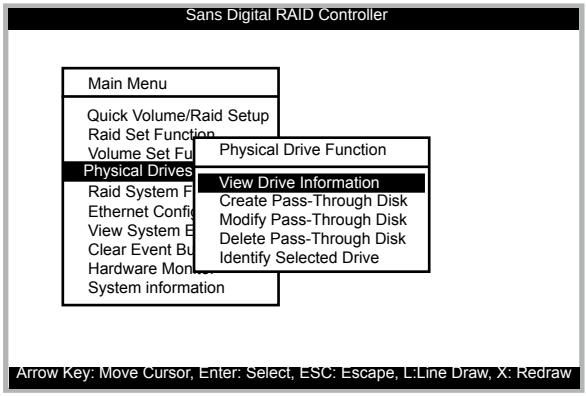
5.5.3.6 Display Volume Set Info.

To display volume set information, move the cursor bar to the desired volume set number, then press **Enter** key. The "Volume Set Information" will show as following. You can only view the information of this volume set.



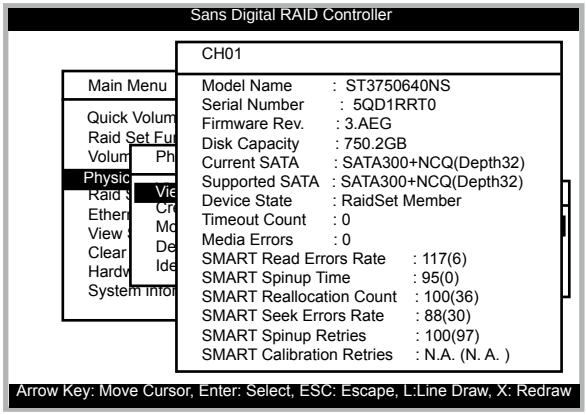
5.5.4 Physical Drives

Choose this option from the Main Menu to select a physical disk and to perform the operations listed below.

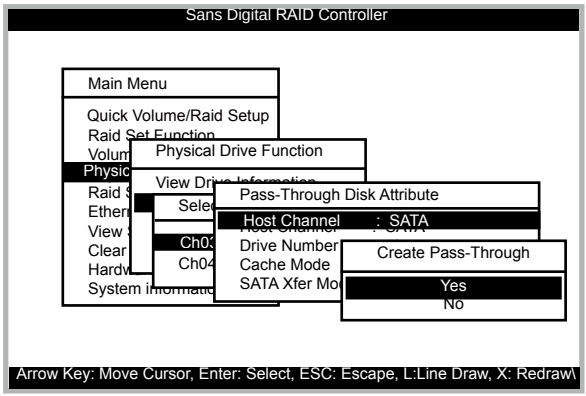


5.5.4.1 View Drive Information

When you choose this option, the physical disks in the MobileRAID MR4UT box are listed. Move the cursor to the desired drive and press **Enter**. The following appears:


Sans Digital RAID Controller
CH01
Main Menu
Model Name : ST3750640NS
Serial Number : 5QD1RRT0
Firmware Rev. : 3.AEG
Disk Capacity : 750.2GB
Current SATA : SATA300+NCQ(Depth32)
Supported SATA : SATA300+NCQ(Depth32)
Device State : RaidSet Member
Timeout Count : 0
Media Errors : 0
SMART Read Errors Rate : 117(6)
SMART Spinup Time : 95(0)
SMART Reallocation Count : 100(36)
SMART Seek Errors Rate : 88(30)
SMART Spinup Retries : 100(97)
SMART Calibration Retries : N.A. (N. A.)
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

5.5.4.2 Create Pass-Through Disk



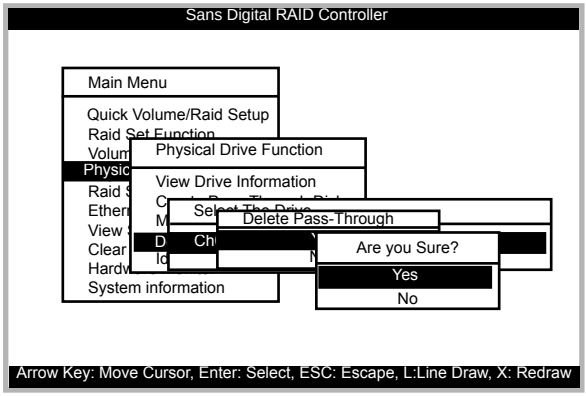
Disk drive is not controlled by the RAID box firmware, thus, it can not be a part of a volume set. The disk drive is available to the operating system as an individual disk. It is typically used on a system where the operating system is on a disk not controlled by the RAID box firmware. The Host Channel, Drive Number, Cache Mode and SATA Xfer Mode items detailed descriptioin refer to the “Create Volume Set” section.

5.5.4.3 Modify Pass-Through Disk

Use this option to modify the "Pass-Through Disk Attribute". To modify Pass-Through Disk parameters values from "Pass-Through Disk" pool, move the cursor bar to the "Physical Drive Function" menu and select the "Modify Pass-Through Drive" option and then press **Enter** key. The "Physical Drive Function" menu will show all Raid Pass-Through Drive number option. Move the cursor bar to a desired item, then press **Enter** key to show all Pass-Through Disk attribute. Select the parameter from the list you which to change, press **Enter** key to modify it.

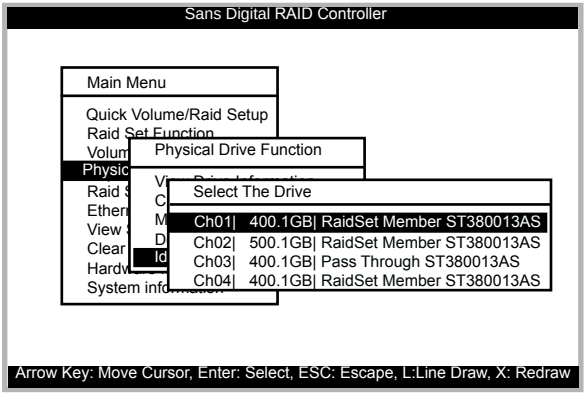
5.5.4.4 Delete Pass-Through Disk

To delete Pass-Through drive from the Pass-through drive pool, move the cursor bar to the "Physical Drive Function" menu and select the "Delete pass-through Disk" item, then press **Enter** key. The "Delete Pass-Through" confirmation screen will appear and press **Yes** key to delete it.

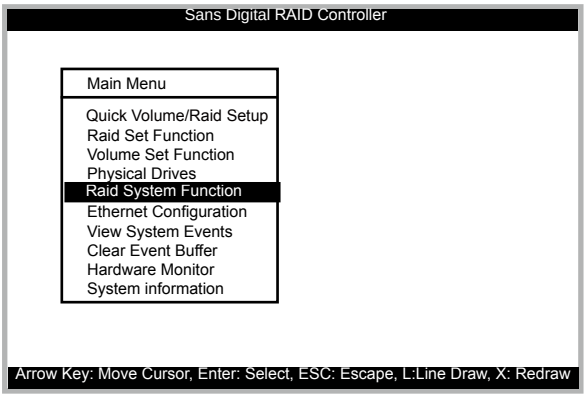


5.5.4.5 Identify Selected Drive

To prevent removing the wrong drive, the selected disk Fault LED Indicator will light for physically locating the selected disk when the "Identify Selected Device" is selected.


Sans Digital RAID Controller
Main Menu
Quick Volume/Raid Setup
Raid Set Function
Physical Drive Function
Select The Drive
Ch01| 400.1GB| RaidSet Member ST380013AS
Ch02| 500.1GB| RaidSet Member ST380013AS
Ch03| 400.1GB| Pass Through ST380013AS
Ch04| 400.1GB| RaidSet Member ST380013AS
Arrow Key: Move Cursor, Enter: Select, ESC: Escape, L:Line Draw, X: Redraw

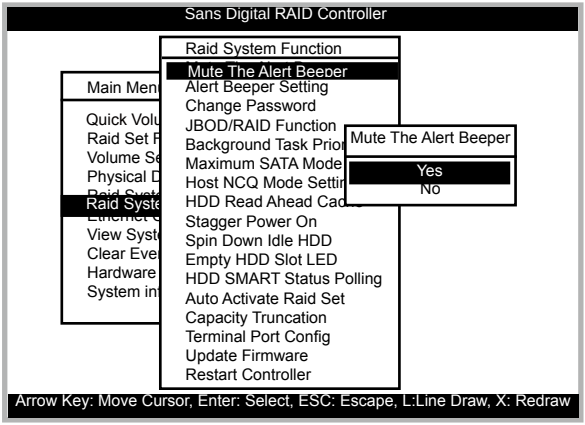
5.5.5 Raid System Function



To set the "Raid System Function", move the cursor bar to the main menu and select the "Raid System Function" item and then press **Enter** key. The "Raid System Function" menu will show all items. Move the cursor bar to an item, then press **Enter** key to select the desired function.

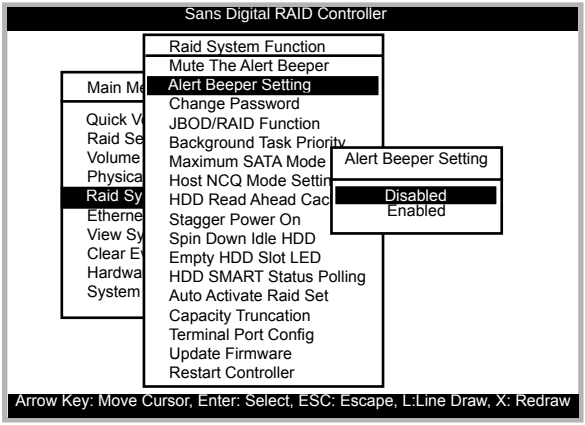
5.5.5.1 Mute The Alert Beeper

The "Mute The Alert Beeper" function item is used to control the RAID box beeper. Select the **Yes** and press **Enter** key in the dialog box to turn the beeper off.



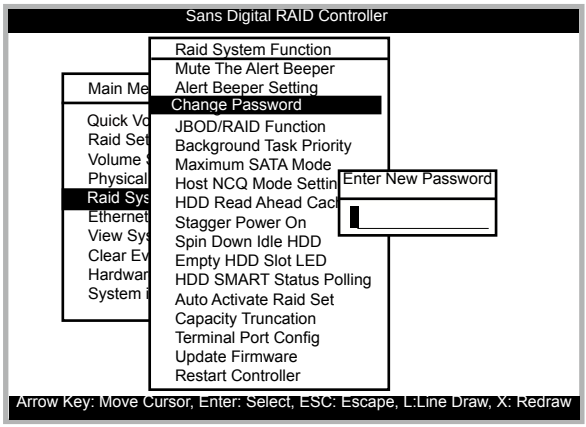
5.5.5.2 Alert Beeper Setting

The "Alert Beeper Setting" function item is used to control the RAID box beeper. Select "**Disabled"** and press **Enter** key in the dialog box to turn the beeper off.



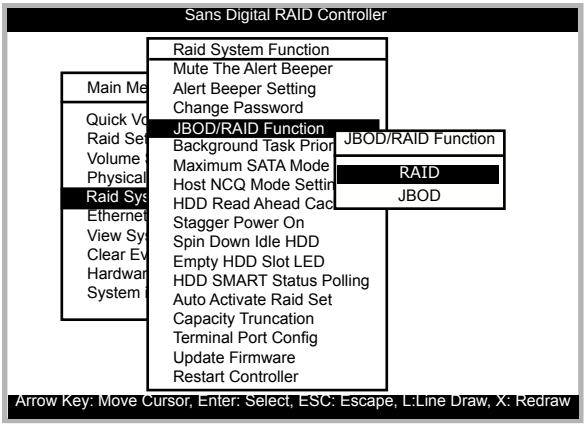
5.5.5.3 Change Password

The "Change Password" option allows user to set or clear the password protection feature. Once the password has been set, the user only can monitor and configure the controller by providing the correct password. This feature is used to protect the RAID box from unauthorized entry. The RAID box will check the password only when entering the main menu from the initial screen. The system will automatically go back to the initial screen when it does not receive any command in 5 minutes.
To set or change the password, move the cursor to "Raid System Function" screen, press the "Change Password" item. An "Enter New Password" screen appears. Do not use spaces when you enter the password, If spaces are used, it will lock out the user. To disable the password, press **Enter** only in both the "Enter New Password" and "Re-Enter New Password" column. The existing password will be cleared. No password checking will occur when entering the main menu from the starting screen.

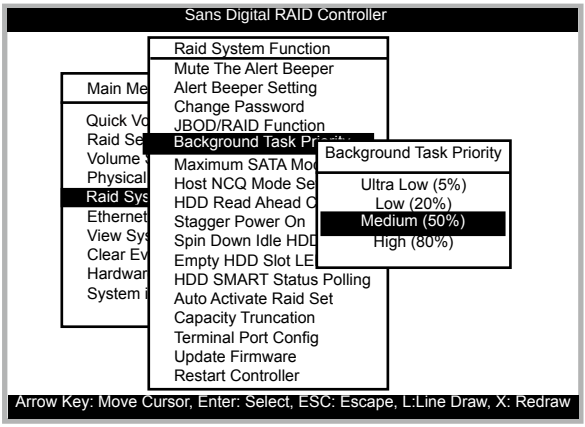


5.5.5.4 JBOD/RAID Function

JBOD is an acronym for "Just a Bunch Of Disk". A group of hard disks in a RAID box are not set up as any type of RAID configuration. All drives are available to the operating system as an individual disk. JBOD does not provide data redundancy. User needs to delete the RAID set, when you want to change the option from the RAID to the JBOD function.



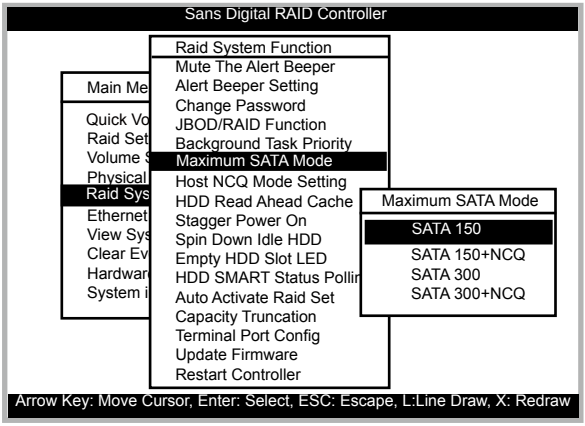
5.5.5.5 Background Task Priority



The "Background Task Priority" is a relative indication of how much time the controller devotes to a background operation, such as rebuilding or migrating. The RAID box allows user to choose the rebuild priority to balance volume set access and background tasks appropriately.

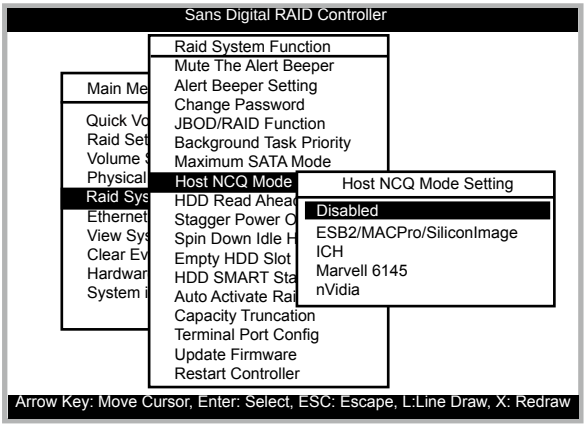
5.5.5.6 Maximum SATA Mode

Within the RAID box, the eSATA/USB2.0 acts as a target and 4 SATA ll bus are connected to the drive. The SATA drive channel can support up to SATA ll, which runs up to 300MB/s. NCQ is a command protocol in Serial ATA that can only be implemented on native Serial ATA hard drives. It allows multiple commands to be outstanding within a drive at the same time. Drives that support NCQ have an internal queue where outstanding commands can be dynamically rescheduled or re-ordered, along with the necessary tracking mechanisms for outstanding and completed portions of the workload. The RAID box allows user to choose the SATA Mode: SATA150, SAT150+NCQ, SAT300, SATA300+NCQ.



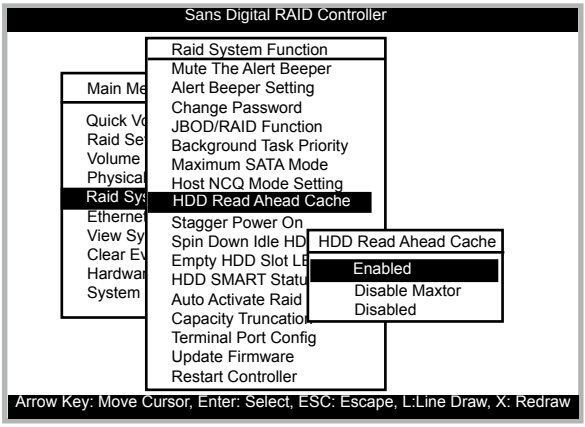
5.5.5.7 Host NCQ Mode Setting

NCQ is a performance enhancement for SATA II-category disk drives, and works similarly to the way command tag queuing (CTQ) works in SCSI command set-based disk drives. NCQ algorithms allow I/O operations to be performed out of order to optimize and leverage disk read/write head positioning and ultimately overall performance. Since there are some compatible with MR4UT, It provides the following option to tune the function. The default setting on this option is Disable for better compatibility. The MobileRAID MR4UT provides the following host NCQ mode setting.



Disable: No NCQ support
ESB2/MACPro/Siliconlimage: Intel ESB2, MACPro and Siliconimage SATA controller.
ICH: Intel ICH series SATA controller
Marvell6145: Marvell 6145 SATA controller
nVidia: Nvida SATA controller

5.5.5.8 HDD Read Ahead Cache

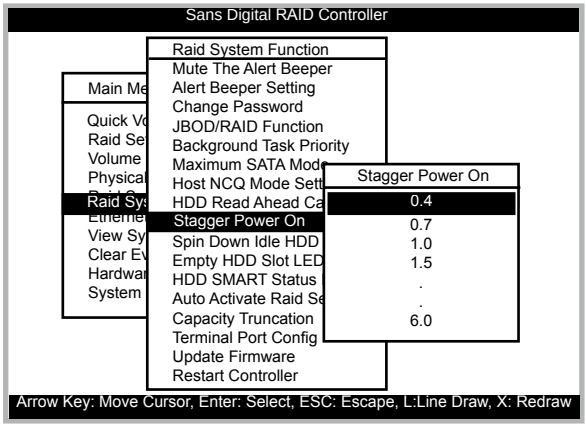


Allow Read Ahead (Default: Enabled)—When Enabled, the drive' s read ahead cache algorithm is used, providing maximum performance under most circumstances.

5.5.5.9 Stagger Power On

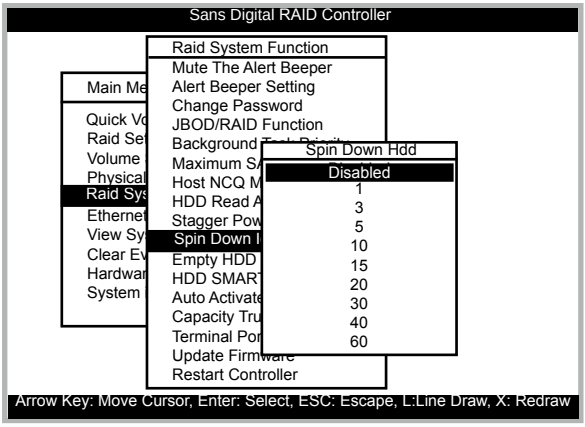
In a PC system with only one or two drives, the power can supply enough power to spin up both drives simultaneously. But in systems with more than two drives, the startup current from spinning up the drives all at once can overload the power supply, causing damage to the power supply, disk drives and other system components. This damage can be avoided by allowing the host to stagger the spin-up of the drives. New SATA drives have support staggered spin-up capabilities to boost reliability. Staggered spin-up is a very useful feature for managing multiple disk drives in a storage subsystem. It gives the host the ability to spin up the disk drives sequentially or in groups, allowing the drives to come ready at the optimum time without straining the system power supply. Staggering drive spin-up in a multiple drive environment also avoids the extra cost of a power supply designed to meet short-term startup power demand as well as steady state conditions.

The RAID box has included the option for customer to select the disk drives sequentially stagger power up value. The values can be selected from 0.4s to 6s per step which powers up one drive.



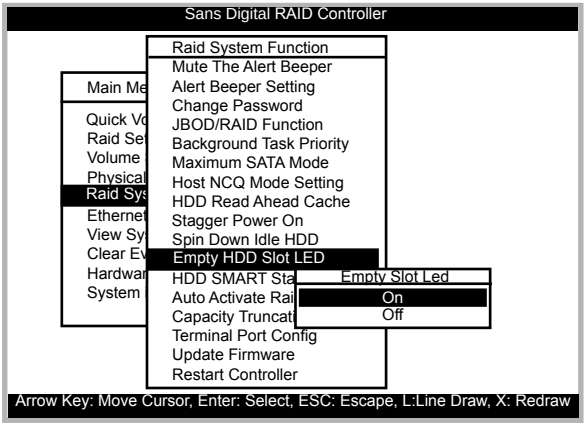
5.5.5.10 Spin Down Idle HDD

This function can automatically spin down the drive if it hasn't been accessed for a certain amount of time. This value is used by the drive to determine how long to wait (with no disk activity, before turning off the spindle motor to save power.)



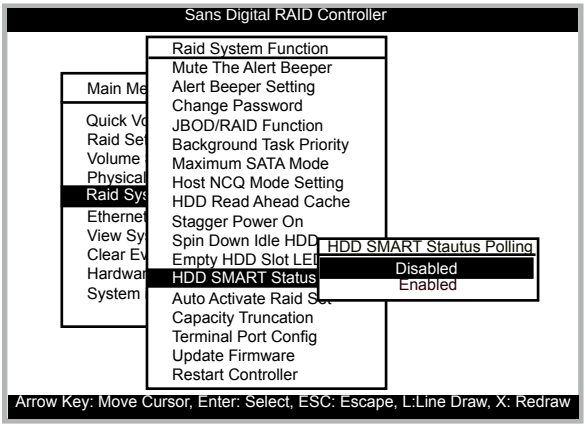
5.5.5.11 Empty HDD Slot LED

The firmware has added the "Empty HDD Slot LED" option to setup the Fault LED light "ON "or "OFF". When each slot has a power LED for the HDD installed identify, user can set this option to "OFF". Choose option "ON", the MR4UT RAID box will light the Fault LED; if no HDD installed.

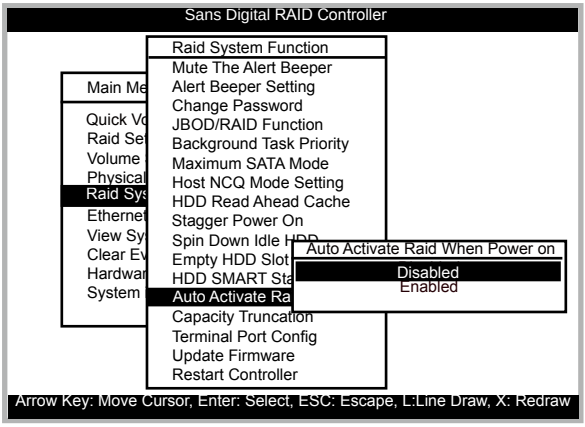


5.5.5.12 HDD SMART Status Polling

"HDD SMART Status Polling" was added to enable scanning of the HDD temperature function. It is necessary to enable "HDD SMART Status Polling" function before SMART information is accessible. This function is disabled by default.The following screen shot shows how to change the setting to enable the polling function.



5.5.5.13 Auto Activate Raid Set

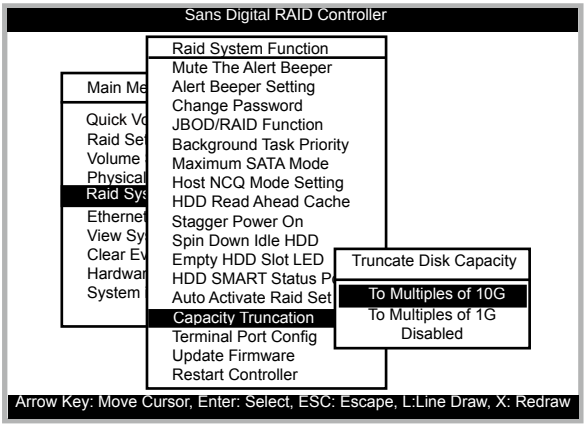


When some of the disk drives are removed in power off state or boot up, the raid set state will change to Incomplete State. But if a user wants to automatically continue to work while the SAS RAID controller is powered on, the user can set the auto Activate Raid Set option to enable. The Raid State will change to Degraded Mode while it powers on.

5.5.5.14 Capacity Truncation

The RAID box uses drive truncation so that drives from differing vendors are more likely to be able to be used as spares for each other. Drive truncation slightly decreases the usable capacity of a drive that is used in redundant units.

The controller provides three truncation modes in the system configuration: Multiples Of 10G, Multiples Of 1G and No Truncation.



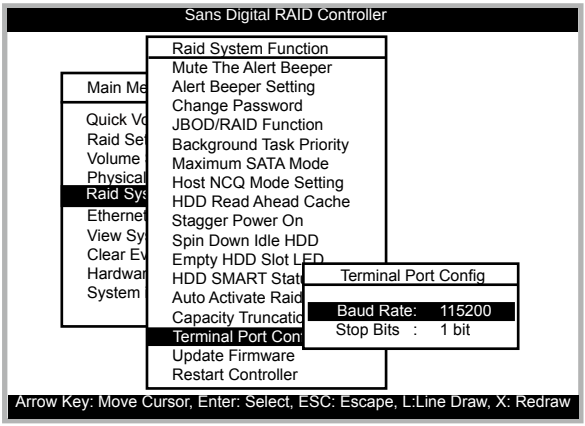
Multiples Of 10G: If you have 120 GB drives from different vendors; chances are that the capacity varies slightly. For example, one drive might be 123.5 GB, and the other 120 GB. "Multiples Of 10G" truncates the number under tens. This makes the same capacity for both of these drives so that one could replace the other.
Multiples Of 1G: If you have 123 GB drives from different vendors; chances are that the capacity varies slightly. For

example, one drive might be 123.5 GB, and the other 123.4 GB. "Multiples Of 1G" truncates the fractional part. This makes the same capacity for both of these drives so that one could replace the other.

Disabled: It does not truncate the capacity.

5.5.5.15 Terminal Port Config

Parity Value is fixed at None.
Handshaking value is fixed at None.
Speed sending values are 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.
Stop Bits values are 1 bit and 2 bits.



5.5.5.16 Update Firmware

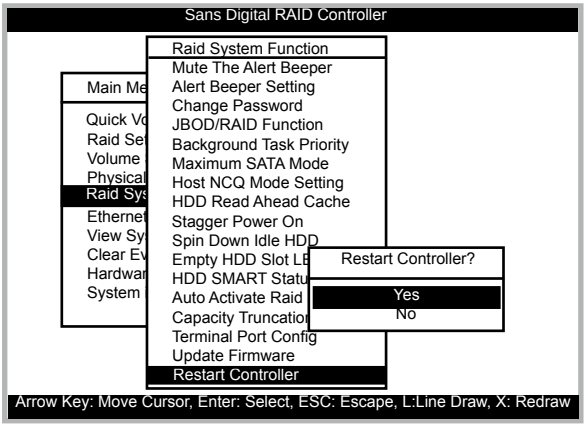
Please refer to the appendix A Upgrading Flash Firmware Programming Utility.

Note:

1. User can only update the firmware through the VT100 Terminal or web browser-based RAID Management through the controller's serial port or LAN port.

5.5.5.17 Restart Controller

Use the "Restart Controller" function to restart the RAID box, move the cursor bar to the main menu "Raid System Function" item and then press the **Enter** key. The "Raid system Function" menu appears on the screen. Press **Enter** key to select "Restart Controller" item. The restart controller confirmation screen appears. Select **Yes** key to restart entire MobileRAID MR4UT.

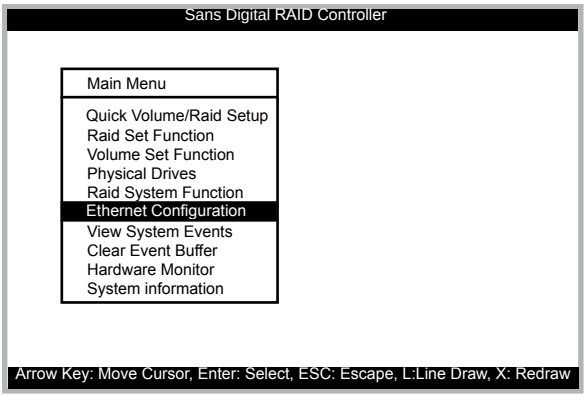


Note:

It can only work properly at Host and Drive without any activity.

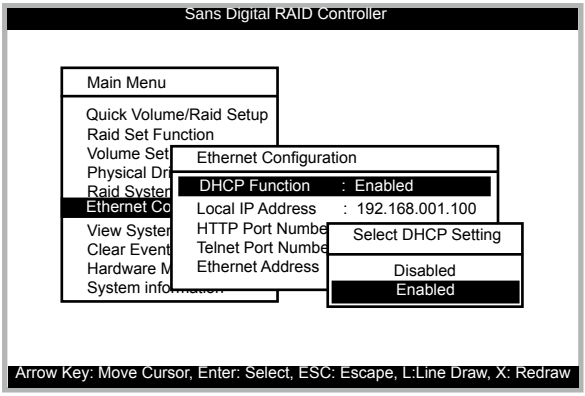
5.5.6 Ethernet Configuration

Use this feature to set the controller Ethernet port configuration. Customer doesn't need to create a reserved space on the arrays before the Ethernet port and HTTP service working.

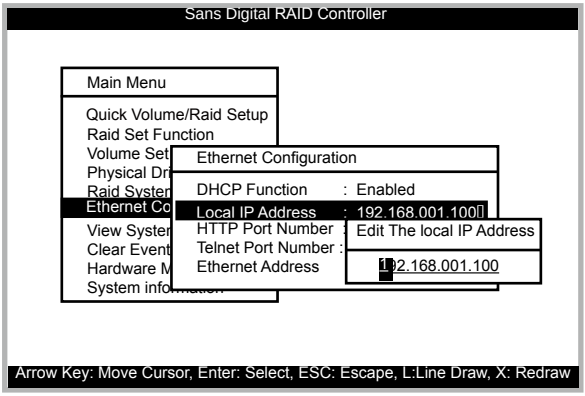


5.5.6.1 DHCP Function

DHCP (Dynamic Host Configuration Protocol) is a protocol that lets network administrators manage centrally and automate the assignment of IP (Internet Protocol) configurations on a computer network. When using the Internet's set of protocols (TCP/IP), in order for a computer system to communicate to another computer system it needs a unique IP address. Without DHCP, the IP address must be entered manually at each computer system. DHCP lets a network administrator supervise and distribute IP addresses from a central point. The purpose of DHCP is to provide the automatic (dynamic) allocation of IP client configurations for a specific time period (called a lease period) and to eliminate the work necessary to administer a large IP network. To manually configure the IP address of the controller, move the cursor bar to the main menu "Ethernet Configuration" function item and then press the **Enter** key. The "Ethernet Configuration" menu appears on the screen. Move the cursor bar to "DHCP Function" item, then press **Enter** key to show the DHCP setting. Select the "Disabled' or 'Enabled" option to enable or disable the DHCP function.



5.5.6.2 Local IP Address

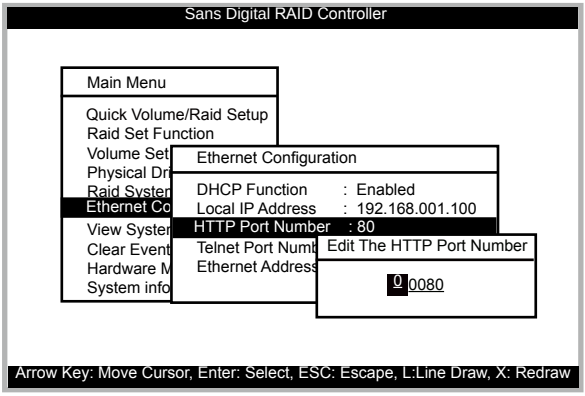


If you intend to set up your client computers manually, make sure that the assigned IP address is in the same range of your default router address and that it is unique to your private network. However we would highly recommend that if you have a network of computers and the option to assign your TCP/IP client configurations automatically, please do. An IP address allocation scheme will reduce the time it takes to set-up client computers and eliminate the possibilities of administrative errors. To manually configure the IP address of the RAID box, move the cursor bar to the main menu "Ethernet Configuration" function item and then press the **Enter** key. The "Ethernet Configuration" menu appears on the screen. Move the cursor

bar to Local IP Address item, then press **Enter** key to show the default address setting in the RAID controller. You can reassign the IP address of the controller.

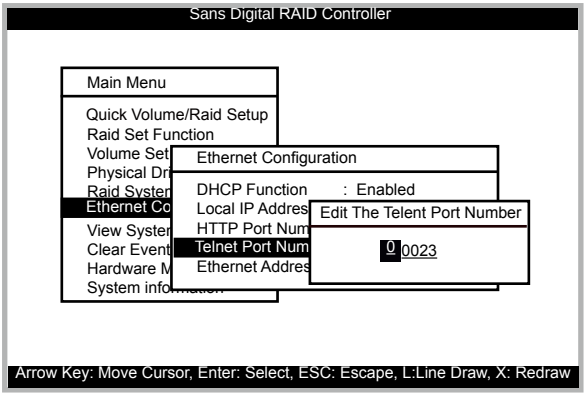
5.5.6.3 HTTP Port Number

To manually configure the "HTTP Port Number" of the controller, move the cursor bar to the main menu "Ethernet Configuration" function item and then press the **Enter** key. The "Ethernet Configuration" menu appears on the screen. Move the cursor bar to "HTTP Port Number" item, then press the **Enter** key to show the default address setting in the RAID controller. You can then reassign the default" HTTP Port Number" of the control



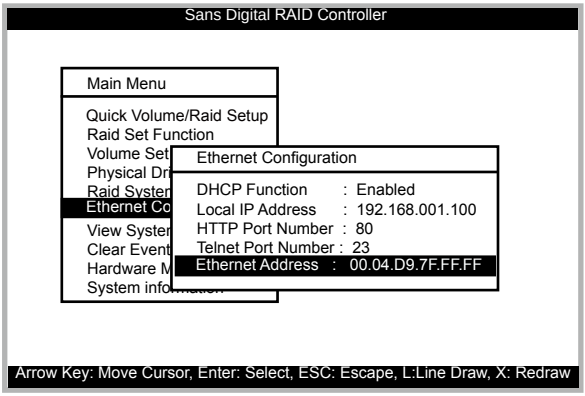
5.5.6.4 Telent Port Number

To manually configure the "Telent Port Number" of the controller, move the cursor bar to the main menu "Ethernet Configuration" function item and then press the **Enter** key. The "Ethernet Configuration" menu appears on the screen. Move the cursor bar to "Telent Port Number" item, then press the **Enter** key to show the default address setting in the RAID controller. You can then reassign the default Telent Port Number of the controller.

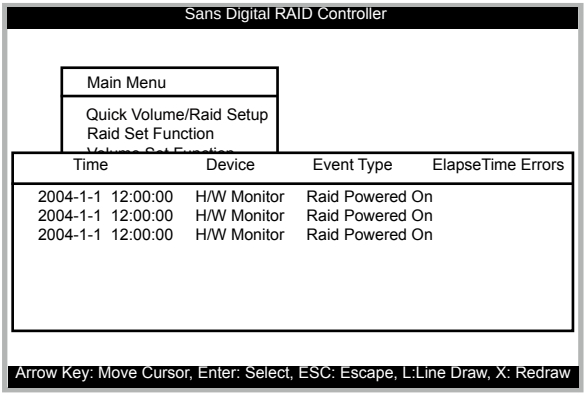


5.5.6.5 Ethernet Address

A MAC address stands for Media Access Control address and is your computer's unique hardware number. On an Ethernet LAN, it's the same as your Ethernet address. When you're connected to the Internet from the RAID controller Ethernet port, a correspondence table relates your IP address to the RAID controller's physical (MAC) address on the LAN.



5.5.7 View System Events



To View System Events, move the cursor bar to the main menu and select the "View System Events" link, then press the **Enter** key The RAID box's events screen appear.

Choose this option to view the system events information: Time, Device, Event type, Elapse Time and Errors. The RAID box does not built the real time clock. The time information is the relative time from the RAID box power on.

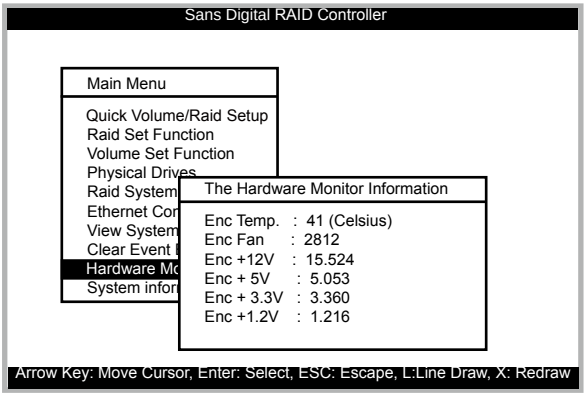
5.5.8 Clear Events Buffer

Use this feature to clear the entire events buffer information.

5.5.9 Hardware Monitor Information

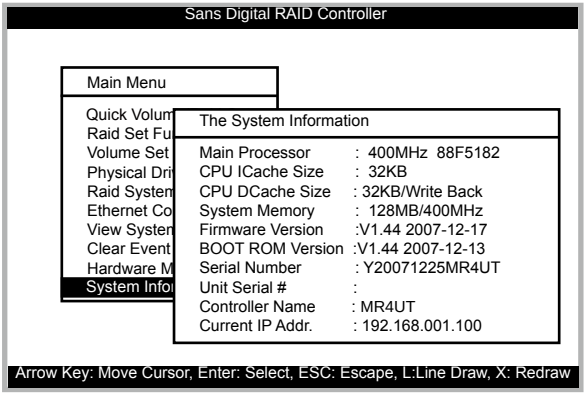
The "Hardware Monitor Information" provides the temperature, fan speed (chassis fan) and voltage of the RAID box. The temperature items list the current states of the controller board and backplane. All items are also unchangeable. The warning messages will indicate through the LCM, LED and alarm buzzer.

Below screen is "Hardware Monitor Information".



Item	Warning Condition
Enclosure Board Temperature	**> 60º**
Enclosure Fan Speed	**< 1900 RPM**
Enclosure Power Supply +12V	**< 10.5V or > 13.5V**
Enclosure Power Supply +5V	**< 4.7V or > 5.3V**
Enclosure Power Supply +3.3V	**< 3.0V or > 3.6V**
CPU Core Voltage +1.2V	**< 1.08V or > 1.32V**

5.5.10 System Information



Choose this option to display main processor, CPU Instruction cache and data cache size, firmware version, serial number, controller model name, and the cache memory size. To check the system information, move the cursor bar to "System Information" item, then press **Enter** key. All major controller system information will be displayed.

6. Web Browser-based Configuration

The RAID box web browser-based configuration utility is firmware-based and uses to configure raid sets and volume sets. Use this utility to:

- Create raid set,
- Expand raid set,
- Define volume set,
- Add physical drive,
- Modify volume set,
- Modify RAID level/stripe size,
- Define pass-through disk drives,
- Modify system function,
- Update firmware and,
- Designate drives as hot spares.

If you need to boot the operating system from a RAID box, you must first create a RAID volume by using LCD panel, RS232 or Ethernet LAN port.

6.1 Firmware-embedded TCP/IP & web browser-based RAID manager (using the controller's 10/100 LAN port)

To ensure proper communications between the RAID box and Web browser-based RAID management, Please connect the RAID system LAN port to any LAN switch port.

The RAID box has embedded the TCP/IP & Web Browser-based RAID manager in the firmware. User can remote manage the RAID box without adding any user specific software (platform independent) via standard web browsers directly connected to the 10/100 RJ45 LAN port.

To configure RAID box on a local or remote machine, you need to know its IP Address. The IP address will default show in the LCD screen. Launch your firmware-embedded TCP/IP & Web Browser-based RAID manager by entering http://[IP Address] in the web browser.

You must be logged in as administrator with local admin rights on the remote machine to remotely configure it. The RAID box default User Name is “admin” and the Password is “0000”.

6.2 Web Browser Start-up Screen

The web browser start-up screen will display the current configuration of your RAID box. It displays the Raid Set List, Volume Set List and Physical Disk List. The raid set information, volume set information and drive information can also be viewed by clicking on the “RaidSet Hierarchy” screen. The current configuration can also be viewed by clicking on “RaidSet Hierarchy” in the menu.

To display raid set information, move the mouse cursor to the desired raid set number, then click it. The raid set information will show in the screen.

To display volume set information, move the mouse cursor to the desired volume set number, then click it. The volume set information will show in the screen.

To display drive information, move the mouse cursor to the desired physical drive number, then click it. The drive information will show in the screen.

6.2.1 Main Menu

The main menu shows all function that enables the customer to execute actions by clicking on the appropriate link.

Individual Category	Description
Quick Function	Create a default configuration, which is based on the number of physical disk installed; it can modify the volume set Capacity, Raid Level, and Stripe Size.
RaidSet Functions	Create a customized RAID set.
VolumeSet Functions	Create customized volume sets and modify the existed volume sets parameter.
Physical Drives	Create pass through disks and modify the existed pass through drives parameter. It also provides the function to identify the respect disk drive.
System Controls	Setting the RAID system configurations
Information	View the controller information. The "RaidSet Hierarchy" can also view through the "RaidSet Hierarchy" item.

6.3 Quick Function

6.3.1 Quick Create

The number of physical drives in the raid controller determines the RAID levels that can be implemented with the RAID set. You can create a RAID set associated with exactly one volume set. The user can change the raid level, stripe size, and capacity. A hot spare option is also created depending upon the existing configuration.
The host "Channel: Drive #" setting default set is "SATA&USB".
Tick on the "Confirm The Operation" and click on the "Submit" button in the "Quick Create" screen, the raid set and volume set will start to initialize.

Note:

In "Quick Create" your volume set is automatically configured based on the number of disks in your system. Use the "Raid-Set functions" and "VolumeSet functions" if you prefer to customize your system.

6.4 RaidSet Functions

Use the "RaidSet Functions" and "VolumeSet Functions" if you prefer to customize your system. User manual configuration can full control of the raid set setting, but it will take longer to complete than the "Quick Function". Select the "RaidSet Functions" to manually configure the RAID set for the first time or deletes existing RAID set and reconfigures the RAID set. A RAID set is a group of disks containing one or more volume sets.

6.4.1 Create Raid Set

To create a RAID set, click on the "Create Raid Set" link. A "Select The SATA Drive For RAID Set" screen is displayed showing the SATA drive connected to the current RAID box. Click on the selected physical drives with the current raid set. Enter 1 to 15 alphanumeric characters to define a unique identifier for a raid set. The default raid set name will always appear as Raid Set. #. Tick on the "Confirm The Operation" and click on the "Submit" button in the screen, the raid set will start to initialize.

6.4.2 Delete Raid Set

To delete a RAID set, click on the "Delete Raid Set" link. A "Select The RAID SET To Delete" screen is displayed showing all RAID set existing in the current controller. Click the RAID set number you which to delete in the select column to delete screen.
Tick on the "Confirm The Operation" and click on the "Submit" button in the screen to delete it.

6.4.3 Expand Raid Set

Use this option to expand a RAID set, when a disk is added to your RAID box. This function is active when at least one drive is available.

To expand a raid set, click on the "Expand Raid Set" link. Select the target raid set, which you want to expand it.
Tick on the available disk and "Confirm The Operation", and then click on the "Submit" button in the screen to add disks to the raid set.

6.4.4 Offline Raid Set

This function is for customer being able to unmount and remount a multi-disk volume. All Hdds of the selected raid set will be put into offline state and spun down and fault LED will be in fast blinking mode.

6.4.5 Activate Raid Set

When one of the disk drive is removed in power off state, the RAID set state will change to "Incomplete State". If user wants to continue to work, when the RAID box is power on. User can use the "Activate Raid Set" option to active the RAID set. After user complete the function, the Raid State will change to "Degraded Mode". To activate the incomplete the raid set, click on the Activate Raid Set link. Then "Select The RAID SET To Activate" screen is displayed showing all raid set existing in the current controller. Click the raid set number you which to activate in the select column. Click on the "Submit" button in the screen to activate the raid set that has removed one of disk drive in the power off state. The RAID box will continue to work in degraded mode.

6.4.6 Create Hot Spare

When you choose the "Create Hot Spare" option in the "RaidSet Functions", all unused physical devices connected to the current controller appear: Select the target disk by clicking on the appropriate check box. Tick on the "Confirm The Operation", and click on the "Submit" button in the screen to create the hot spares. The "Create Hot Spare" option gives you the ability to define a global hot spare.

6.4.7 Delete Hot Spare

Select the target Hot Spare disk to delete by clicking on the appropriate check box.

Tick on the "Confirm The Operation", and click on the "Submit" button in the screen to delete the hot spares.

6.4.8 Rescue RaidSet

When the system is power off in the RAID set update period, it may be disappeared in this abnormal condition. The "RESCUE" function can recover the missing Raid set information.

The RAID controller uses the time as the Raid set signature. The Raid set may have different time after the Raid set is recovered. The "SIGANT" function can regenerate the signature for the Raid set.

6.5 VolumeSet Functions

A volume set is seen by the host system as a single logical device. It is organized in a RAID level with one or more physical disks. RAID level refers to the level of data performance and protection of a volume set. A volume set capacity can consume all or a portion of the disk capacity available in a raid set. Multiple volume sets can exist on a group of disks in a raid set. Additional volume sets created in a specified raid set will reside on all the physical disks in the raid set. Thus each volume set on the raid set will have its data spread evenly across all the disks in the raid set.

6.5.1 Create Volume Set

The following is the volume set features for the MobileRAID MR4UT.

1. Volume sets of different RAID levels may coexist on the same raid set.
2. Up to 4 volume sets in a raid set can be created by the SATA RAID controller. (With Host controller supported port multiplier function)
3. The maximum addressable size of a single volume set is not limited to two TB, because the controller is capable of 64-bit LBA mode. However the operating system itself may not be capable of addressing more than two TB.

To create volume set from raid set system, move the cursor bar to the main menu and click on the Create Volume Set link. The Select The Raid Set To Create On It screen will show all raid set number. Tick on a raid set number that you want to create and then click on the "Submit" button.

The new create volume set allows user to select the Volume Name, RAID Level, Capacity, Initialization Mode, Strip Size, Cache mode, SATA Data Xfer Mode and Channel: Drive#.

• Volume Name
The default volume name will always appear as Volume Set. #. You can rename the volume set name providing it does not exceed the 15 characters limit.

• Raid Level
Set the RAID level for the volume set. Highlight Raid Level and press **Enter**.
The available RAID levels for the current volume set are displayed. Select a RAID level and press **Enter** to confirm it.

• Capacity
The maximum volume size is default in the first setting. Enter the appropriate volume size to fit your application.

• Volume Initialization Mode
Press **Enter** key to define "Foreground Initialization" , "Background Initialization" or "No Init (To Rescue Volume)". When "Foreground Initialization", the initialization proceeds must be completed before the volume set ready for system accesses. When background Initialization, the initialization proceeds as a background task, the volume set is fully accessible for system reads and writes. The operating system can instantly access to the newly created arrays without requiring a reboot and waiting the initialization complete. The "No Init (To Rescue Volume)" option is for customer to rescue volume without losing data in the disk.

• Volume Strip Size
This parameter sets the size of the stripe written to each disk in a RAID 0, 1, 10 or 5 logical drive. You can set the stripe size to 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB.

A larger stripe size produces better-read performance, especially if your computer does mostly sequential reads. However, if you are sure that your computer does random reads more often, select a small stripe size.

• Volume Cache Mode
The RAID box supports "Write-Back Cache" and "Write-Through Cache".

• SATA Data Xfer Mode

The MobileRAID MR4UT can support up to SATA ll, which runs up to 300MB/s. NCQ is a command protocol in Serial ATA that can only be implemented on native Serial ATA hard drives. It allows multiple commands to be outstanding within a drive at the same time. Drives that support NCQ have an internal queue where outstanding commands can be dynamically rescheduled or re-ordered, along with the necessary tracking mechanisms for outstanding and completed portions of the workload. The RAID subsystem allows user to choose the SATA Mode (slowest to fastest): SATA150, SATA150+NCQ, SATA300, SATA300+NCQ.

• Channel: Drive#
There are three kinds of host channel option for each volume to select: SATA, USB, or SATA&USB.

SATA: eSATA host channel can access to the volume set.
USB: USB host channel can access to the volume set.
SATA&USB: Both eSATA and USB host channel can concurrently access the volume set. But user can only write through one channel at the time for data consistency.

For eSATA host controller with port multiplier function, the eSATA port can support up to 4 volume sets (Drive#: 0~3, 4~15 for Reserved).
For the host controller without port multiplier function, the eSATA port can only support one volume set (Drive#: 0, 1~15 for Reserved).

But the USB port can support up to 4 volume sets (Drive#: 0~3, 4~15 for Reserved).

6.5.2 Delete Volume Set

To delete volume from "VolumeSet Functions", move the cursor bar to the main menu and click on the "Delete Volume Set" link. Then "Select The Raid Set To Delete" screen will show all RAID set number. Tick on a RAID set number, and "Confirm The Operation", then click on the "Submit" button to the delete volume set.

6.5.3 Modify Volume Set

To modify a volume set from a raid set:
(1). Click on the "Modify Volume Set" link.
(2). Tick on the volume set from the list that you want to modify, then click the "Submit" button. The following screen appears.
Use this option to modify volume set configuration. To modify volume set, move the cursor bar to the volume set menu and click on it. The modify value screen appears. Move the cursor bar to an attribute item, and then click on the attribute to modify the value. After you complete the modification, tick on the "Confirm The Operation" and click on the "Submit" button to complete the action. User can modify all values except the capacity.

6.5.3.1 Volume Expansion

Use this raid set expands to expand a raid set, when a disk is added to your system. The expand capacity can use to enlarge the volume set size or create another volume set. The modify volume set function can support the volume set expansion function. To expand volume set capacity value from raid set system function, move the cursor bar to the volume set Volume capacity item and entry the capacity size. Tick on the "Confirm The Operation" and click on the "Submit" button to complete the action. The volume set start to expand.

6.5.3.2 Volume Set Migration

Migrating occurs when a volume set is migrating from one RAID level to another, a volume set strip size changes, or when a disk is added to a raid set. Migration status is displayed in the volume status area of the "RaidSet Hierarchy" screen.

6.5.4 Check Volume Set

To check a volume set from a raid set:

1. Click on the "Check Volume Set" link.
2. Tick on the volume set from the list that you wish to check. Tick on "Confirm The Operation" and click on the "Submit" button. Use this option to verify the correctness pf the redundant data in a volume set. For example, in a system with dedicated parity, volume set check means computing the parity of the data disk drives and comparing the results to the contents of the dedicated parity disk drive. The checking percentage can also be viewed by clicking on "RaidSet Hierarchy" in the main menu.

6.5.5 Stop Volume Set Check

Use this option to stop the "Check Volume Set" function.

6.6 Physical Drive

Choose this option from the Main Menu to select a physical disk and to perform the operations listed below.

6.6.1 Create Pass Through

To create pass-through disk, move the mouse cursor to the main menu and click on the "Create Pass Through" link. The relative setting function screen appears.

Disk is no controlled by the RAID box firmware, thus, it can not be a part of a volume set. The disk is available to the operating system as an individual disk. It is typically used on a system where the operating system is on a disk not controlled by the RAID firmware. User can also select the Volume Cache Mode, SATA Data Xfer Mode and Channel Drive# for this volume.

6.6.2 Modify Pass Through

Use this option to modify the Pass Through. User can modify the Volume Cache Mode, SATA Data Xfer Mode and Channel:Drive# on an existed pass through disk.

To modify the pass through, move the mouse cursor bar to click on "Modify Pass Through" link. The "Select The Pass Through Disk For Modification" screen appears, select the drive which you want to modify, then click on the "Submit" button.

The "Enter Pass-Through Disk Attribute" screen appears, modify the drive attribute values as you want. After you complete the selection, click on the "Confirm The Operation" and "Submit" button to complete the selection action.

6.6.3 Delete Pass Through Disk

To delete pass-through drive, move the mouse cursor bar to the main menus and click on "Delete Pass Through" link. Select the drive which you want to delete, and select "Confirm The Operation", then click on the "Submit" button to complete the delete action.

6.6.4 Identify Drive

To prevent removing the wrong drive, the selected disk Fault LED will light for physically locating the selected disk when the "Identify Drive" is selected.
To identify the selected drive from the drives pool, move the mouse cursor bar to click on "Identify Drive" link. The "Select The IDE Device For Identification" screen appears tick on the IDE device from the drives pool and Flash method. After completing the selection, click on the "Submit" button to identify selected drive.

6.7 System Controls

6.7.1 System Configuration

To set the RAID box function, move the cursor bar to the main menu and click on the "System Controls" link. The System Configuration menu will show all items. Move the cursor bar to an item, then press **Enter** key to select the desired function.

• System Beeper Setting
The "System Beeper Setting" function item is used to "Disabled" or "Enabled" the RAID box alarm tone generator.

• Background Task Priority
The Raid "Background Task Priority" is a relative indication of how much time the RAID box devotes to a background operation such as rebuilding or migrating. The RAID box allows user to choose the background priority to balance volume set access and background tasks appropriately. For high array performance, specify a Low value.

• Terminal Port Configuration
Speed setting values are 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.
Stop Bits values are 1 bit and 2 bits.
Note: Parity value is fixed at None.
Data Bits value is fixed at 8 bits.

• JBOD/RAID Configuration

JBOD is an acronym for "Just a Bunch Of Disk". A group of hard disks in a RAID box are not set up as any type of RAID configuration. All drives are available to the operating system as an individual disk. JBOD does not provide data redundancy. User needs to delete the RAID set, when you want to change the option from the RAID to the JBOD function.

• Max SATA Mode Supported

Within the RAID box, the host eSATA / USB 2.0 channels act as a target and 4 Serial ATA ll bus are connected to the drive. The SATA ll drive channel can support up to SATA ll, which runs up to 300MB/s. NCQ is a command protocol in Serial ATA that can only be implemented on native Serial ATA hard drives. It allows multiple commands to be outstanding within a drive at the same time. Drives that support NCQ have an internal queue where outstanding commands can be dynamically rescheduled or reordered, along with the necessary tracking mechanisms for outstanding and completed portions of the workload. The RAID box allows user to choose the SATA Mode: SATA150, SAT150+NCQ, SAT300, SATA300+NCQ.

• Host NCQ Mode Setting

NCQ is a performance enhancement for SATA II-category disk drives, and works similarly to the way command tag queuing (CTQ) works in SCSI command set-based disk drives. NCQ algorithms allow I/O operations to be performed out of order to optimize and leverage disk read/write head positioning and ultimately overall performance. Since there are some compatible with MobileRAID MR4UT, it provides the following option to tune the function. The default setting on this option is Disable for better compatibility. The MobileRAID MR4UT provides the following host NCQ mode setting.

Disable: No NCQ support
ESB2/MACPro/Siliconlimage: Intel ESB2, MACPro and Siliconimage SATA controller
ICH: Intel ICH series SATA controller
Marvell6145: Marvell 6145 SATA controller
nVidia: Nvida SATA controller

• HDD Read Ahead Cache

Allow Read Ahead (Default: Enabled)—When Enabled, the drive's read ahead cache algorithm is used, providing maximum performance under most circumstances.

• Stagger Power On Control

In a PC system with only one or two drives, the power can supply enough power to spin up both drives simultaneously. But in systems with more than two drives, the startup current from spinning up the drives all at once can overload the power supply, causing damage to the power supply, disk drives and other system components. This damage can be avoided by allowing the host to stagger the spin-up of the drives. New SATA drives have support staggered spin-up capabilities to boost reliability. Staggered spin-up is a very useful feature for managing multiple disk drives in a storage subsystem. It gives the host the ability to spin up the disk drives sequentially or in groups, allowing the drives to come ready at the optimum time without straining the system power supply. Staggering drive spin-up in a multiple drive environment also avoids the extra cost of a power supply designed to meet short-term startup power demand as well as steady state conditions.

Sans Digital RAID controller has included the option for customer to select the disk drives sequentially stagger power up value. The values can be selected from 0.4s to 6s per step which powers up one drive.

• Spin Down Idle HDD (Minutes)

This function can automatically spin down the drive if it hasn't been accessed for a certain amount of time. This value is used by the drive to determine how long to wait (with no disk activity, before turning off the spindle motor to save power.)

• Empty HDD Slot LED

The firmware has added the "Empty HDD Slot LED" option to setup the Fault LED light "ON "or "OFF". When each slot has a power LED for the HDD installed identify, user can set this option to "OFF". Choose option "ON", the MobileRAID MR4UT will light the Fault LED; if no HDD installed.

• HDD SMART Status Polling

"HDD SMART Status Polling" was added to enable scanning of the HDD temperature function. It is necessary to enable "HDD SMART Status Polling" function before SMART information is accessible. This function is disabled by default.

• Auto Activate Incomplete Raid

When some of the disk drives are removed in power off state or boot up, the raid set state will change to Incomplete State. But if a user wants to automatically continue to work while the SAS RAID controller is powered on, the user can set the auto Activate Raid Set option to enable. The Raid State will change to Degraded Mode while it powers on.

• Disk Capacity Truncation Mode

Sans Digital box use drive truncation so that drives from differing vendors are more likely to be able to be used as spares for each other. Drive truncation slightly decreases the usable capacity of a drive that is used in redundant units.
The controller provides three truncation modes in the system configuration: "Multiples Of 10G", "Multiples Of 1G", and "No Truncation".

Multiples Of 10G: If you have 120 GB drives from different vendors; chances are that the capacity varies slightly. For example, one drive might be 123.5 GB, and the other 120 GB. "Multiples Of 10G" truncates the number under tens. This makes the same capacity for both of these drives so that one could replace the other.
Multiples Of 1G: If you have 123 GB drives from different vendors; chances are that the capacity varies slightly. For example, one drive might be 123.5 GB, and the other 123.4 GB. "Multiples Of 1G" truncates the fractional part. This makes the same capacity for both of these drives so that one could replace the other.

Disabled: It does not truncate the capacity.

6.7.2 EtherNet Config

Use this feature to set the controller Ethernet port configuration. Customer doesn't need to create a reserved space on the arrays before the Ethernet port and HTTP service working. The firmware-embedded Web Browser-based RAID manager can access it from any standard internet browser or from any host computer either directly connected or via a LAN or WAN with no software or patches required.
DHCP (Dynamic Host Configuration Protocol) is a protocol that lets network administrators manage centrally and automate the assignment of IP (Internet Protocol) configurations on a computer network. When using the Internet's set of protocols (TCP/IP), in order for a computer system to communicate to another computer system it needs a unique IP address. Without DHCP, the IP address must be entered manually at each computer system. DHCP lets a network administrator supervise and distribute IP addresses from a central point. The purpose of DHCP is to provide the automatic (dynamic) allocation of IP client configurations for a specific time period (called a lease period) and to eliminate the work necessary to administer a large IP network.

To configure the raid controller Ethernet port, move the cursor bar to the main menu and click on the "System Controls" link. The System Controls menu will show all items. Move the cursor bar to the "Ethernet Config" item, then press **Enter** key to select the desired function.

6.7.3 Alert By Mail Config

To configure the raid box mail function, move the cursor bar to the main menu and click on the "System Controls" link. The "System Controls" menu will show all items. Move the cursor bar to the "Alert By Mail Config" item, then press **Enter** key to select the desired function. This function can only set by the web-based configuration.

The firmware contains SMTP manager monitors all system events and user can select either single or multiple user notifications to be sent via "Plain English" e-mails with no software required.

When you open the mail configuration page, you will see following settings:

SMTP server IP Address: Enter the SMTP server IP address which is not McRAID storage manager IP. Ex: 192.168.0.2

Sender Name: Enter the sender name that will be shown in the outgoing mail. Ex: RaidController_1

Mail address: Enter the sender email that will be shown in the outgoing mail, but don't type IP to replace domain name.
Ex: RaidController_1@sansdigital.com

Account: Enter the valid account if your SMTP mail server need authentication.

Password: Enter the valid password if your SMTP mail server need authentication.

6.7.4 SNMP Configuration

To configure the raid controller SNMP function, move the cursor bar to the main menu and click on the "System Controls" link. The "System Controls" menu will show all items. Move the cursor bar to the" SNMP Configuration" item, then press **Enter** key to select the desired function. This function can only set by the web-based configuration.

The firmware contains SNMP Agent manager monitors all system events and user can use the SNMP function from the web setting with no Agent software required.
Please refer to Appendix D SNMP operation & Definition for more detail information about the SNMP trap and definition.

- **SNMP Trap Configurations**

Enter the SNMP Trap IP Address.

- **SNMP System Configurations**

About community, Community name acts as a password to screen accesses to the SNMP agent of a particular network device. Type in the community names of the SNMP agent. Before access is granted to a request station, this station must incorporate a valid community name into its request; otherwise, the SNMP agent will deny access to the system.

Most network devices use "public" as default of their community names. This value is case-sensitive.

- **SNMP Trap Notification Configurations**

Please refer to Appendix D of Event Notification Table.

6.7.5 View Events/Mute Beeper

To view the RAID box system events information, move the mouse cursor to the main menu and click on the "View Events/ Mute Beeper" link. The RAID box "System Events Information" screen appears.

Choose this option to view the system events information: Timer, Device, Event type, Elapse Time and Errors. The RAID box does not built the real time clock. The time information is the relative time from the RAID box power on.

6.7.6 Generate Test Event

Use this feature to generate a event to test the email address which configures by the "Altert By Mail Config" option.

6.7.7 Clear Events Buffer

Use this feature to clear the entire events buffer information.

6.7.8 Modify Password

To set or change the RAID box password, move the mouse cursor to "System Controls" screen, and click on the "Change Password" link. The "Modify System Password" screen appears.
The password option allows user to set or clear the raid box's password protection feature. Once the password has been set, the user can only monitor and configure the raid box by providing the correct password.

The password is used to protect the internal RAID box from unauthorized entry. The controller will check the password only when entering the main menu from the initial screen. The RAID subsystem will automatically go back to the initial screen when it does not receive any command in 5 miuntes. Do not use spaces when you enter the password, If spaces are used, it will lock out the user.

To disable the password, press **Enter** key only in both the "Enter New Password" and "Re-Enter New Password" column. Once the user confirms the operation and clicks the "Submit" button. The existing password will be cleared. No password checking will occur when entering the main menu from the starting screen.

6.7.9 Upgrade Firmware

Please refer to the appendix A Upgrading Flash Firmware programing.

6.7.10 Restart Controller

Use the "Restart Controller" function to restart the RAID box.

6.8 Information Menu

6.8.1 RaidSet Hierarchy

Use this feature to view the MobileRAID MR4UT current raid set, current volume set and physical disk configuration. Please refer to this chapter "Configuring Raid Sets and Volume Sets"

6.8.2 System Information

To view the RAID box information, move the mouse cursor to the main menu and click on the "System Information" link. The "Raid Subsystem Information" screen appears.

Use this feature to view the raid subsystem controller's information. The Controller Name, Firmware Version, BOOT ROM Version, serial number, Main Processor, CPU ICache Size, CPU DCache Size , System Memory size/speed appear and Current IP Address in this screen.

6.8.3 Hardware Monitor

To view the RAID box hardware monitor information, move the mouse cursor to the "Information" and click the "Hardware Monitor" link. The "Hardware Monitor Information" screen appears. The "Hardware Monitor Information" provides the temperature, fan speed (chassis fan) and voltage of the RAID box. All items are also unchangeable. The warning messages will indicate through the LCM, LED and alarm buzzer.

Item	Warning Condition
Enclosure Board Temperature	**> 60°**
Enclosure Fan Speed	**< 1900 RPM**
Enclosure Power Supply +12V	**< 10.5V or > 13.5V**
Enclosure Power Supply +5V	**< 4.7V or > 5.3V**
Enclosure Power Supply +3.3V	**< 3.0V or > 3.6V**
CPU Core Voltage +1.2V	**< 1.08V or > 1.32V**

Appendix A

Upgrading Flash Firmware Programming Utility

Since the RAID box features flash firmware, it is not necessary to change the hardware flash chip in order to upgrade the RAID firmware. The user can simply re-program the old firmware through the RS-232 port or Lan Port. New releases of the firmware are available in the form of a DOS file at OEM's FTP. The file available at the FTP site is usually a self-extracting file that contains the following:

MR4UTXXXX.BIN Firmware Binary (where "XXXX" refers to the function name:BOOT, FIRM and MBR0)
MR4UT BOOT.BIN:→ RAID controller hardware initialization in the MR4UT.
MR4UT FIRM.BIN:→ RAID kernal program
MR4UT MBR0.BIN:→ Master Boot Record for supporting Dual Flash Image in the MobileRAID MR4UT.

README.TXT it contains the history information of the firmware change. Read this file first before upgrading the firmware.
These files must be extracted from the compressed file and copied to one directory in drive A: or C:.

Establishing the Connection for the RS-232

The firmware can be downloaded to the RAID box controller by using an ANSI/VT-100 compatible terminal emulation program or HTTP web browser management. You must complete the appropriate installation procedure before proceeding with this firmware upgrade. Please refer to chapter 4.3, "VT100 terminal (Using the controller's serial port)" for details on establishing the connection. Whichever terminal emulation program is used must support the ZMODEM file transfer protocol.

Upgrade Firmware Through ANSI/VT-100 Terminal Emulation

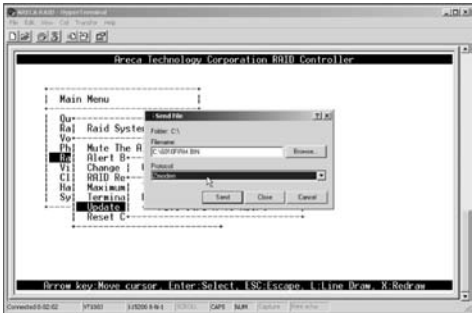
Get the new version firmware for your RAID subsystem controller. For Example, download the bin file from your OEM's web site onto the c:

1. From the Main Menu, scroll down to "Raid System Function"
2. Choose the "Update Firmware", The "Update The Raid Firmware" dialog box appears.

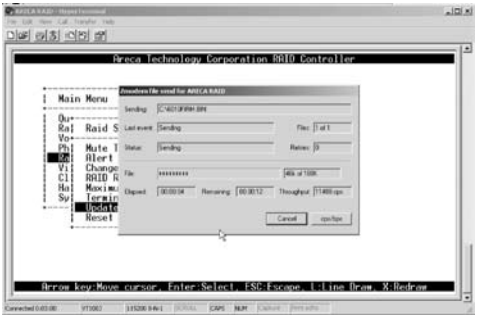
3. Go to the tool bar and select Transfer. Open Send File.

4. Select "ZMODEM modem" under Protocol. ZMODEM as the file transfer protocol of your terminal emulation software.

5. Click "Browse". Look in the location where the Firmware upgrade software is located. Select the File name:


Areca Technology Corporation RAID Controller
Main Menu
Arrow key:Move cursor, Enter:Select, ESC:Escape, L:Line Draw, X:Redraw

6. Click "Send", to send the Firmware Binary to the controller.


Areca Technology Corporation RAID Controller
Main Menu
Arrow key:Move cursor, Enter:Select, ESC:Escape, L:Line Draw, X:Redraw

7. When the Firmware completes downloading, the confirmation screen appears. Press **Yes** to start program the flash ROM.

8. When the Flash programming starts, a bar indicator will show "Start Updating Firmware. Please Wait".

9. The Firmware upgrade will take approximately thirty seconds to complete.

10. After the Firmware upgrade is complete, a bar indicator will show "Firmware Has Been Updated Successfully".

Note:

1. The user doesn't need to reconfigure all of the settings after the firmware upgrade is complete, because all of the settings will keep us the vaules before upgrade.
2. Please update all binary code (BOOT, FIRM and MBR0) before you reboot the MR4UT. Otherwise, a mixed firmware package may hang the MobileRAID MR4UT.

Upgrade Firmware Through Web Browser Manager (LAN Port)

Get the new version firmware for your RAID box. For example, download the bin file from your OEM's web site onto the c:

1. To upgrade the RAID box firmware, move the mouse cursor to "Upgrade Firmware" link. The "Upgrade The Raid System Firmware" screen appears.

2. Click "Browse". Look in the location where the firmware upgrade file is located. Select the file name:
"MR4UTFIRM.BIN" and click open.

3. Click the "Confirm The Operation" and press the "Submit" button.

4. The Web Browser begins to download the firmware binary to the controller and start to update the flash ROM.

5. After the firmware upgrade is complete, a bar indicator will show "Firmware has Been Updated Successfully"

Note:

1. The user doesn't need to reconfigure all of the settings after the firmware upgrade is complete, because all of the settings will keep us the vaules before upgrade.
2. Please update all binary code (BOOT, FIRM and MBR0) before you reboot the MR4UT. Otherwise, a mixed firmware package may hang the MobileRAID MR4UT.

Appendix B

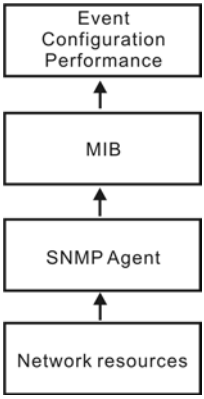
SNMP Operation & Definition

Overview

The Internal RAID subsystem firmware-embedded Simple Network Management Protocol (SNMP) agent for the connect array. An SNMP-based management application (also known as an SNMP manager) can monitor the disk array. An example of An SNMP management application is Hewlett-Packard's Open View. The firmware-embedded SNMP agent ca be used to augment the RAID controller if you are already running a SNMP management application at your site.

SNMP Definition

SNMP, an IP-based protocol, has a set of commands for getting the status of target devices. The SNMP management platform is called the SNMP manager, and the managed devices have the SNMP agent loaded. Management data is organized in a hierarchical data structure called the management Information Base (MIB). These MIBs are defined and sanctioned by various industry associations. The objective is for all vendors to create products in compliance with these MIBs so that inter-vendor interoperability can be achieved. If a vendor wishes to include additional device information that is not specified in a standard MIB, then that is usually done through MIB extensions.



SNMP Installation

The installation of the SNMP manager is accomplished in several phases:

- Installing the Manager software on the client
- Placing a copy of the management information base (MIB) in a directory which is accessible to the management application
- Compiling the MIB description file with the management application

MIB Compilation and Definition File creation

Before the manager application accesses the RAID controller, user needs to integrate the MIB into the management application's database of events and status indicator codes. This process is known as compiling the MIB into the application. This process is highly vendor-specific and should be well-covered in the User's Guide of your SNMP application. Ensure the compilation process successfully integrates the contents of the Sansdigital.MIB file into the traps database.

Location for MIB

Depending upon the SNMP management application used, the MIB must be placed in a specific directory on the network management station running the management application. The MIB file must be manually copied to this directory. For example:

SNMP Management Application	MIB Location
HP OpenView	\OV\MIBS
Netware NMS	\NMS\SNMPMIBS\CURRENT

Your management application may have a different target directory. Consult the management application's user manual for the correct location.

Appendix C

Technical Support

Sans Digital Technical Support provides several options for users to access information and updates. We encourage you to use one of our electric services, which provide product information updates for the most efficient service and support. If you decide to contact us, please have the information such as Product model and serial number, BIOS and driver version, and a description of the problem.

Appendix D

Event Notification Configurations

The controller classifies disk array events into four levels depending on their severity. These include level 1: Urgent, level 2: Serious, level 3: Warning and level 4: Information. The level 4 covers notificational events such as initialization of the controller and initiation of the rebuilding process; Level 2 covers notification events which once have happen; Level 3 includes events which require the issuance of warning messages; Level 1 is the highest level, and covers events the need immediate attention (and action) from the administrator. The following lists sample events for each level:

A. Device Event

Event	Level	Meaning	Action
Device Inserted	Warning	HDD inserted	
Device Removed	Warning	HDD removed	
Reading Error	Warning	HDD reading error	Keep Watching HDD status, may be it caused by noise or HDD unstable.
Writing Error	Warning	HDD writing error	Keep Watching HDD status, may be it caused by noise or HDD unstable.
ATA Ecc Error	Warning	HDD ECC error	Keep Watching HDD status, may be it caused by noise or HDD unstable.
Change ATA Mode	Warning	HDD change ATA mode	Check HDD connection
Time Out Error	Warning	HDD time out	Keep Watching HDD status, maybe it caused by noise or HDD unstable.
Device Failed	Urgent	HDD failure	Replace HDD
PCI Parity Error	Serious	PCI parity error	If only happen once, it may be caused by noise. If always happen, please check power supply or contact to us.
Device Failed(SMART)	Urgent	HDD SMART failure	Replace HDD

PassThrough Disk Created	Inform	Pass Through Disk created	
PassThrough Disk Modified	Inform	Pass Through Disk modified	
PassThrough Disk Deleted	Inform	Pass Through Disk deleted	

B. Volume Event

Event	Level	Meaning	Action
Start Initialize	Warning	Volume initialization has started	
Start Rebuilding	Warning	Volume rebuilding has started	
Start Migrating	Warning	Volume migration has started	
Start Checking	Warning	Volume parity checking has started	
Complete Init	Warning	Volume initialization completed	
Complete Rebuild	Warning	Volume rebuilding completed	
Complete Migrate	Warning	Volume migration completed	
Complete Check	Warning	Volume parity checking completed	
Create Volume	Warning	New volume created	
Delete Volume	Warning	Volume deleted	
Modify Volume	Warning	Volume modified	
Volume Degraded	Urgent	Volume degraded	Replace HDD
Volume Failed	Urgent	Volume failure	
Failed Volume Revived	Urgent	Failed Volume revived	
Abort Initialization	Warning	Initialization been aborted	
Abort Rebuilding	Warning	Rebuilding aborted	
Abort Migration	Warning	Migration aborted	
Abort Checking	Warning	Parity check aborted	
Stop Initialization	Warning	Initialization stopped	
Stop Rebuilding	Warning	Rebuilding stopped	
Stop Migration	Warning	Migration stopped	
Stop Checking	Warning	Parity check stopped	

C. RAID Set Event

Event	Level	Meaning	Action
Create RaidSet	Warning	New raidset created	
Delete RaidSet	Warning	Raidset deleted	
Expand RaidSet	Warning	Raidset expanded	
Rebuild RaidSet	Warning	Raidset rebuilding	
RaidSet Degraded	Urgent	Raidset degraded	Replace HDD

D. Hardware Monitor Event

Event	Level	Meaning	Action
DRAM 1-Bit ECC	Urgent	DRAM 1-Bit ECC error	Check DRAM
DRAM Fatal Error	Urgent	DRAM fatal error encountered	Check the DRAM module and replace with new one if required.
Controller Over Temperature	Urgent	Abnormally high temperature detected on controller (over 60 degree)	Check air flow and cooling fan of theenclosure, and contact us.
Hdd Over Temperature	Urgent	Abnormally high temperature detected on Hdd (over 55 degree)	Check air flow and cooling fan of the enclosure.
Fan Failed	Urgent	Cooling Fan # failure or speed below 1700RPM	Check cooling fan of the enclosure and replace with a new one if required.
Controller Temp. Recovered	Serious	Controller temperature back to normal level	
Hdd Temp. Recovered			
Raid Power On	Warning	Raid power on	
Test Event	Urgent	Test event	
Power On With Battery Backup	Warning	Raid power on with battery backuped	
Incomplete RAIDDiscovered	Serious	Some RAID set member disks missing before power on	Check disk information to find out which channel missing.
HTTP Log In	Serious	a HTTP login detected	

Telnet Log	Serious	a Telnet login detected	
InVT100 Log In	Serious	a VT100 login detected	
API Log In	Serious	a API login detected	
Lost Rebuilding/ MigrationLBA	Urgent	Some rebuilding/ migration raidset member disks missing before power on.	Reinserted the missing member disk back, controller will continue the incompleted rebuilding/ migration.

Note:

It depends on models, not every model will encounter all events.

Appendix E

RAID Concept

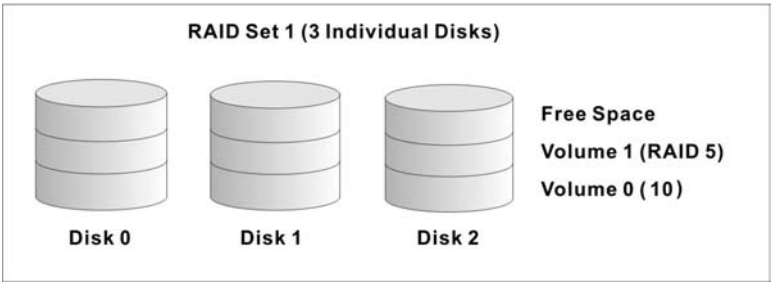
RAID Set

A Raid Set is a group of disk containing one or more volume sets. It has the following features in the RAID box. A volume Set must be created either on an existing raid set or on a group of available individual disks (disks that are not yet a part of an raid set). If there are pre-existing raid sets with available capacity and enough disks for specified RAID level desired, then the volume set will be created in the existing raid set of the user's choice. If physical disk of different capacity are grouped together in a raid set, then the capacity of the smallest disk will become the effective capacity of all the disks in the raid set.

Volume Set

A Volume Set is seen by the host system as a single logical device. It is organized in a RAID level with one or more physical disks. RAID level refers to the level of data performance and protection of a Volume Set. A Volume Set capacity can consume all or a portion of disk capacity available in a RAID Set. Multiple Volume Sets can exist on a group of disks in a Raid Set.

In the illustration below, Volume 1 can be assigned a RAID 5 level of operation while Volume 0 might be assigned a RAID 10 level of operation.



Easy of Use Features

Instant Availability/Background Initialization

RAID 0 and RAID 1 volume sets can be used immediately after creation because they do not create parity data. However, RAID 3 and 5 volume sets must be initialized to generate parity information. In Normal Initialization, the initialization proceeds as a background task, and the volume set is fully accessible for system reads and writes. The operating system can instantly access the newly created arrays without requiring a reboot and without waiting for initialization to complete. Furthermore, the RAID volume set is protected against a single disk failure while initialing. If using Fast Initialization, the initialization process must be completed before the volume set is ready for system accesses.

Array Roaming

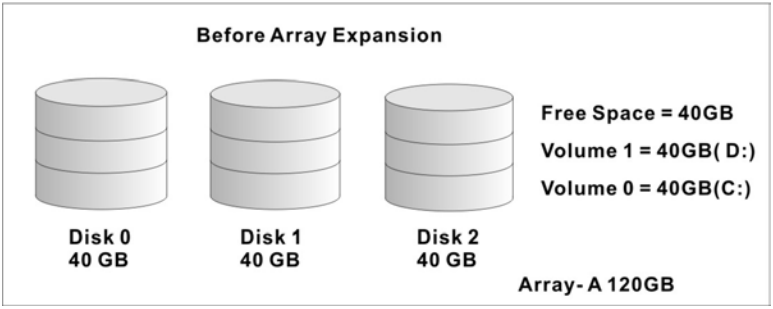
The RAID box store RAID configuration information on the disk drives. The adapters therefor protect the configuration settings in the event of controller failure. Array roaming allows the administrators the ability to move a completele raid set to another system without losing RAID configuration information or data on that raid set. So, if a server fails, the raid set disk drives can be moved to another server with an identical RAID controller and the disks can be inserted in any order.

Online Capacity Expansion

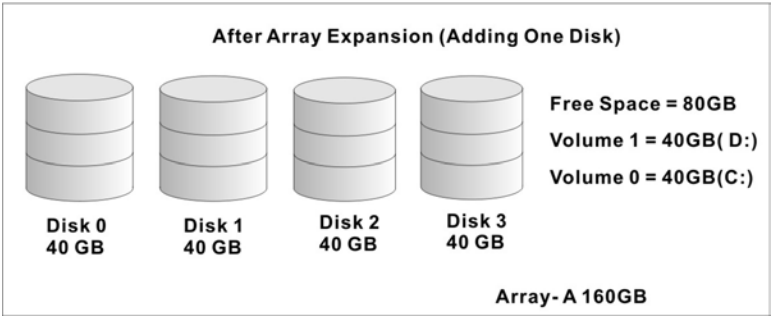
Online Capacity Expansion makes it possible to add one or more physical drives to a volume set without interrupting server operation, eliminating the need to backup and restore after reconfiguration of the raid set. When disks are added to a raid set, unused capacity is added to the end of the raid set. Then, data on the existing volume sets (residing on the newly expanded raid set) is redistributed evenly across all the disks. A contiguous block of unused capacity is made available on the raid set. The unused capacity can be used to create additional volume sets.

A disk, to be added to a Raid set, must be in normal mode (not failed), free (not spare, in a raid set, or passed through to host) and must have at least the same capacity as the smallest disk capacity already in the Raid set.

Capacity expansion is only permitted to proceed if all volumes on the Raid set are in the normal status. During the expansion process, the volume sets being expanded can be accessed by the host system. In addition, the volume sets with RAID levels 1, 10, 3 or 5 are protected against data loss in the event of disk failure(s). In the case of disk failure, the volume set transitions from "migrating" state to "migrating+degraded" state. When the expansion is completed, the volume set would then transition to "degraded" mode. If a global hot spare is present, then it further transitions to the "rebuilding" state.
The expansion process is illustrated as following figure.



The RAID box redistributes the original volume set over the original and newly added disks, using the same fault-tolerance configuration. The unused capacity on the expand raid set can then be used to create an additional volume set, with a different fault tolerance setting (if required by the user.)



The RAID box redistributes the original volume set over the original and newly added disks, using the same fault-tolerance configuration. The unused capacity on the expand raid set can then be used to create an additional volume sets, with a different fault tolerance setting if user need to change.

Online RAID Level and Stripe Size Migration

For those who wish to later upgrade to any RAID capabilities, a system with Sans Digital online RAID level/stripe size migration allows a simplified upgrade to any supported RAID level without havin to reinstall the operating system.

The RAID box can migrate both the RAID level and stripe size of an existing volume set, while the server is online and the volume set is in use. Online RAID level/stripe size migration can prove helpful during performance tuning activities as well as when additional physical disks are added to the RAID box. For example, in a system using two drives in RAID level 1, it is possible to add a single drive and add capacity and retain fault tolerance. (Normally, expanding a RAID level 1 array would require the addition of two disks). A third disk can be added to the existing RAID logical drive and the array can then be migrated from RAID level 1 to 5. The result would be parity fault tolerance and double the available capacity without taking the system down. It is only possible to migrate to a higher RAID level by adding a disk; disks in an existing array can't be reconfigured for a higher RAID level without adding a disk.

Online migration is only permitted to begin If all volume to be migrated are in the normal mode. During the migration process, the volume sets being migrated are accessed by the host system. In addition, the volume sets with RAID levels 1, 10, 3 or 5 are protected against data loss in the event of disk failure(s). In the case of disk failure, the volume set transitions from migrating state to (migrating+degraded) state. When the migration is completed, the volume set transitions to degraded mode. If a global hot spare is present, then it further transitions to rebuilding state.

Online Volume Expansion

Performing a volume expansion on the controller is the process of growing the size of a volume. A more flexible option is for the array to concatenate an additional drive into the RAID set and then expand the volumes on the fly. This happens transparently while the volumes are online, but, at the end of the process, the operating system will detect free space at after the existing volume; the free space will not automatically be incorporated into the existing operating system partition.

Windows, NetWare, and other advanced operating systems support volume expansion, which enables you to incorporate the additional free space within the volume into the operating system partition. The operating system partition is extended to incorporate the free space so it can be used by the operating system without creating a new operating system partition.

You can use the Diskpart.exe command line utility, included with Windows Server 2003 or the Windows 2000 Resource Kit, to extend an existing partition into free space in the Dynamic disk.

Third-party software vendors have created utilities that can be used to repartition disks without data loss. Most of these utilities work offline. Partition Magic is one such utility.

High availability

Global Hot Spares

A Global Hot Spare is an unused online available drive, which is ready for replacing the failure disk. The Global Hot Spares is one of the most important features that RAID box provides to deliver a high degree of fault-tolerance. A global Hot Spare is a spare physical drive that has been marked as a global hot spare and therefore is not a member of any Raid set. If a disk drive used in a RAID Volume Set fails, then the Global Hot spare will automatically take its place and he data previously located on the failed drive is reconstructed on the Global Hot spare.

Important:

The hot spare must have at least the same capacity as the drive it replaces.

For this feature to work properly, the global hot spare must have at least the same capacity as the drive it replaces. Global Hot spares only work with RAID level 1, 10, 3, or 5 volume set.

The Create Hot Spare option gives you the ability to define a global hot spare disk drive. To effectively use the global hot spare feature, you must always maintain at least one drive that is marked as a global spare.

Hot-Swap Disk Drive Support

The RAID box includes a protection circuit that supports the replacement of SATA hard disk drives without having to shut down or reboot the system. A removable hard drive tray can deliver "hot swappable" fault-tolerant RAID solutions at prices much less than the cost of conventional SCSI hard disk RAID controllers. This feature provides advanced fault tolerant RAID protection and "online" drive replacement.

Auto Declare Hot-Spare

If a disk drive is brought online into a system operating in degraded mode, RAID box will automatically declare the new disk as a spare and begin rebuilding the degraded volume. The Auto Declare Hot-Spare function requires that the smallest drive contained within the volume set in which the failure occurred.

In the normal status, the newly installed drive will be reconfigured an online free disk. But, the newly-installed drive is automatically assigned as a hot spare if any hot spare disk was used to rebuild and without new installed drive replaced it. In this condition, the Auto Declare Hot-Spare status will disappeared if the RAID box has since powered off/on.
The Hot-Swap function can be used to rebuild disk drives in arrays with data redundancy such as RAID level 1, 10, 3 and 5.

Auto Rebuilding

If a hot spare is available, the rebuild starts automatically when a drive fails. The RAID box automatically and transparently rebuild failed drives in the background at user-definable rebuild rates.

If a hot spare is not available, the failed disk drive must be replaced with a new disk drive so that the data on the failed drive can be automatically rebuilt and so that fault tolerance can be maintained.

The RAID box will automatically restart the system and the rebuild process if the system is shut down or powered off abnormally during a reconstruction procedure condition.

When a disk is Hot Swapped, although the system is functionally operational, the system may no longer be fault tolerant. Fault tolerance will be lost until the removed drive is replaced and the rebuild operation is completed.

During the automatic rebuild process, system activity will continue as normal, however, the system performance and fault tolerance will be affected.

Adjustable Rebuild Priority

Rebuilding a degraded volume incurs a load on the RAID subsystem. The RAID box allow the user to select the rebuild priority to balance volume access and rebuild tasks appropriately. The Background Task Priority is a relative indication of how much time the controller devotes to a background operation, such as rebuilding or migrating.

The RAID box allows user to choose the task priority (Ultra Low (5%), Low (20%), Medium (50%), High (80%)) to balance volume set access and background tasks appropriately. For high array performance, specify an Ultra Low value. Like volume initialization, after a volume rebuilds, it does not require a system reboot.

APPENDIX

High Reliability

Hard Drive Failure Prediction

In an effort to help users avoid data loss, disk manufacturers are now incorporating logic into their drives that acts as an "early warning system" for pending drive problems. This system is called SMART. The disk integrated controller works with multiple sensors to monitor various aspects of the drive's performance, determines from this information if the drive is behaving normally or not, and makes available status information to RAID controller firmware that probes the drive and look at it.
SMART can often predict a problem before failure occurs. Sans Digital controllers will recognize a SMART error code and notify the administer of an impending hard drive failure.

Auto Reassign Sector

Under normal operation, even initially defect-free drive media can develop defects. This is a common phenomenon. The bit density and rotational speed of disks is increasing every year, and so is the potential of problems. Usually a drive can internally remap bad sectors without external help using cyclic redundancy check (CRC) checksums stored at the end of each sector.

SATA drives perform automatic defect re-assignment for both read and write errors. Writes are always completed - if a location to be written is found to be defective, the drive will automatically relocate that write command to a new location and map out the defective location. If there is a recoverable read error, the correct data will be transferred to the host and that location will be tested by the drive to be certain the location is not defective. If it is found to have a defect, data will be automatically relocated, and the defective location is mapped out to prevent future write attempts.

In the event of an unrecoverable read error, the error will be reported to the host and the location flagged as potentially defective. A subsequent write to that location will initiate a sector test and relocation should that location have a defect. Auto

Reassign Sector does not affect disk subsystem performance because it runs as a background task. Auto Reassign Sector discontinues when the operating system makes a request.

Consistency Check

A consistency check is a process that verifies the integrity of redundant data. For example, performing a consistency check of a mirrored drive assures that the data on both drives of the mirrored pair is exactly the same. To verify RAID 3, or 5 redundancy, a consistency check reads all associated data blocks, computes parity, reads parity, and verifies that the computed parity matches the read parity.

Consistency checks are very important because they detect and correct parity errors or bad disk blocks in the drive. A consistency check forces every block on a volume to be read, and any bad blocks are marked; those blocks are not used again. This is critical and important because a bad disk block can prevent a disk rebuild from completing. We strongly recommend that you run consistency checks on a regular basis—at least once per week. Note that consistency checks degrade performance, so you should run them when the system load can tolerate it.

Data Protection

RECOVERY ROM

The RAID box firmware is stored on the controller flash ROM and is executed by the I/O processor. The firmware can also be updated through Ethernet port (if equipped) without the need to replace any hardware chips. During the controller firmware upgrade flash process, it is possible for a problem to occur resulting in corruption of the controller firmware. With our Redundant Flash image feature, the controller will revert back to the last known version of firmware and continue operating. This reduces the risk of system failure due to firmware crash.

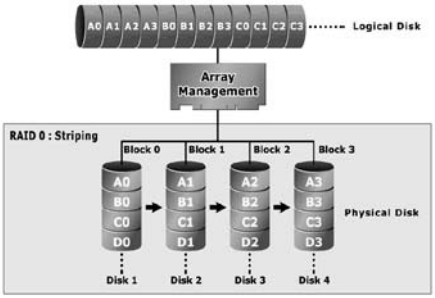
Understanding RAID

RAID is an acronym for Redundant Array of Independent Disks. It is an array of multiple independent hard disk drives that provides high performance and fault tolerance. The RAID box implements several levels of the Berkeley RAID technology. An appropriate RAID level is selected when the volume sets are defined or created. This decision should be based on the desired disk capacity, data availability (fault tolerance or redundancy), and disk performance. The following section discusses the RAID levels supported by the RAID box.

The RAID box makes the RAID implementation and the disks' physical configuration transparent to the host operating stem. This means that the host operating system drivers and software utilities are not affected, regardless of the RAID level selected. Correct installation of the disk array and the controller requires a proper understanding of RAID technology and the concepts.

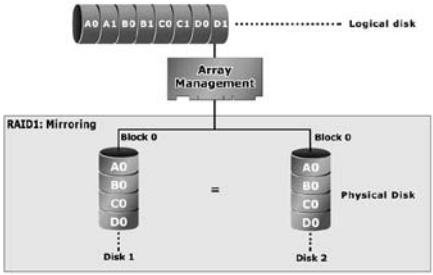
RAID 0

RAID 0, also referred to as striping, writes stripes of data across multiple disk drives instead of just one disk drive. RAID 0 does not provide any data redundancy, but does offer the best high-speed data throughput. RAID 0 breaks up data into smaller blocks and then writes a block to each drive in the array. Disk striping enhances performance because multiple drives are accessed simultaneously; the reliability of RAID Level 0 is less because the entire array will fail if any one disk drive fails, due to a lack of redundancy.



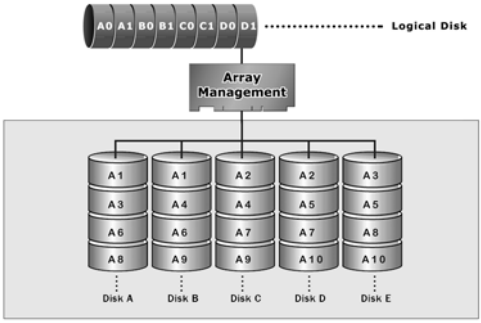
RAID 1

RAID 1 is also known as "disk mirroring"; data written to one disk drive is simultaneously written to another disk drive. Read performance may be enhanced if the array controller can, in parallel, accesses both members of a mirrored pair. During writes, there will be a minor performance penalty when compared to writing to a single disk. If one drive fails, all data (and software applications) are preserved on the other drive. RAID 1 offers extremely high data reliability, but at the cost of doubling the required data storage capacity.



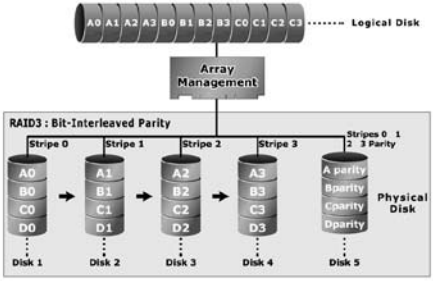
RAID 10

RAID 10 is a combination of RAID 0 and RAID 1, combing stripping with disk mirroring. RAID Level 10 combines the fast performance of Level 0 with the data redundancy of Leve 10. In this configuration, data is distributed across several disk drives, similar to Level 0, which are then duplicated to another set of drive for data protection. RAID 10 has been traditionally implemented using an even number of disks, some hybrids can use an odd number of disks as well. Illustration is an example of a hybrid RAID 10 array comprised of five disks; A, B, C, D and E. In this configuration, each strip is mirrored on an adjacent disk with wrap-around. Sans Digital RAID 10 offers a little more flexibility in choosing the number of disks that can be used to constitute an array. The number can be even or odd.



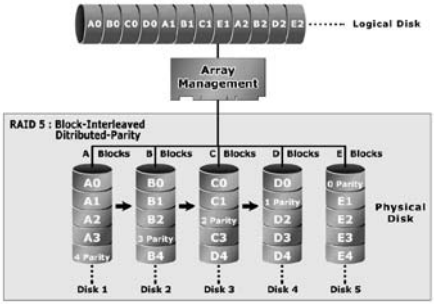
RAID 3

RAID 3 provides disk striping and complete data redundancy though a dedicated parity drive. RAID 3 breaks up data into smaller blocks, calculates parity by performing an exclusive-or on the blocks, and then writes the blocks to all but one drive in the array. The parity data created during the exclusive-or is then written to the last drive in the array. If a single drive fails, data is still available by computing the exclusive-or of the contents corresponding strips of the surviving member disk. RAID 3 is best for applications that require very fast data- transfer rates or long data blocks.



RAID 5

RAID 5 is sometimes called striping with parity at byte level. In RAID 5, the parity information is written to all of the drives in the controllers rather than being concentrated on a dedicated parity disk. If one drive in the system fails, the parity information can be used to reconstruct the data from that drive. All drives in the array system can be used for seek operations at the same time, greatly increasing the performance of the RAID system. This relieves the write bottleneck that characterizes RAID 4, and is the primary reason that RAID 5 is more often implemented in RAID arrays.



JBOD

(Just a Bunch Of Disks) A group of hard disks in a RAID box are not set up as any type of RAID configuration. All drives are available to the operating system as an individual disk. JBOD does not provide data redundancy.

Single Disk (Pass Through Disk)

Pass through disk refers to a drive that is not controlled by the RAID firmware and thus can not be a part of a RAID volume. The drive is available to the operating system as an individual disk.

APPENDIX

Summary of RAID Levels

SATA RAID controller supports RAID Levels 0, 1, 10, 3 and 5. Table below provides a summary of RAID levels.

Features and Performance						
RAID Level	Description	Min. Drives	Max. Drives	Data Reliability	Data Transfer Rate	I/O Request Rates
0	Also known as stripping Data distributed across multiple drives in the array. There is no data protection	1	5	No data Protection	Very High	Very High for Both Reads and Writes
1	Also known as mirroring All data replicated on N Separated disks. N is almost always 2. This is a high availability Solution, but due to the 100% duplication, it is also a costly solution.	2	2	Lower than RAID 6; Higher than RAID 3,5	Writes similar to a single disk	Reads are twice faster than a single disk; Write are similar to a single disk.
10	Also known Block-Interleaved Parity. Data and parity information is subdivided and distributed across all disk. Parity must be the equal to the smallest disk capacity in the array. Parity information normally stored on a dedicated parity disk.	3	5	Lower than RAID 6; Higher than RAID 3,5	Transfer rates more similar to RAID 1 than RAID 0	Reads are twice faster than a single disk; Writes are similar to a single disk.
3	Also known Bit-Interleaved Parity. Data and parity information is subdivided and distributed across all disk. Parity must be the equal to the smallest disk capacity in the array. Parity information normally stored on a dedicated parity disk.	3	5	Lower than RAID 1, 10, 6; Higher than a single drive	Reads are similar to RAID 0; Writes are slower than a single disk	Reads are similar twice faster than a single disk; Writes are similar to a single disk.
5	Also known Block-Interleaved Distributed Parity. Data and parity information is subdivided and distributed across all disk. Parity must be the equal to the smallest disk capacity in the array. Parity information normally stored on a dedicated parity disk.	3	5	Lower than RAID 1, 10, 6; Higher than a single drive.	Reads are similar to RAID 0; Writes are slower than a single disk.	Reads are similar to RAID 0; Writes are slower than a single disk.